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Hotel Huntington, the Headquarters of the Convention.

Central-Station Men Assemble for Pasadena Convention

Final Arrangements Made for Forty-Third Meeting of National Electric Light Association in California City Next Week—Fuel Conservation and Water-Power Development to Be Chief Topics

Fuel conservation by public utilities, a comprehensive report on the water-power possibilities of the United States and action on constitutional amendments having to do with the reorganization of the association are three of the leading subjects that will occupy the attention of the delegates to the forty-third annual convention of the National Electric Light Association which opens in Pasadena, Cal., Tuesday, May 18, and will continue for the remainder of the week.

There are 81 reports and papers on various subjects scheduled to be presented at the four general sessions and eight sectional meetings during the convention. In addition, ten committee meetings will be held during the week.

Everything is ready for the convention. The Hotel Huntington, where the convention headquarters will be located, awaits the delegates and visitors. The Pacific Coast Section of the N. E. L. A. and the convention committee have completed their plans to the last detail, and the stage is set for what promises to be the most successful convention ever held by the association.

Business will be the dominating thought of the convention and the papers to be read and discussed will deal with the most pressing problems of the electrical industry today, and deal with them, not hazily or generally, but specifically and intimately, as the delegates who will present them are among the best informed men in the central-station industry.

Tuesday, the first day of the convention, will be devoted to meetings of the executive committees of the accounting, commercial, electric and technical and hydroelectric sections, followed in the evening by President R. H. Ballard's reception, which will be held in the ballroom of the Hotel Huntington.

The general and sectional meetings will follow an address of welcome by Gov. William D. Stephens of California, after which President

Ballard will deliver his annual address to the delegates.

The convention will then take up the reports of committees, the first important one being the report of the committee on water-power development, of which Franklin T. Griffith, Portland, Ore., is chairman. This report will be a very voluminous one and consist of what is said to be the most comprehensive discussion and compilation of data in connection with water power ever attempted by the electrical interests of the country. Reports on water-power developments now in process of construction, or projected, and an analysis of the water-power situation in all sections of the country will be submitted to the convention.

Consideration of the fuel problems confronting the electrical industry, as well as the country in general, will be one of the dominating notes of the convention and reports and papers having to do with conservation of coal and its more efficient use through the medium of electrical energy properly distributed will be read and discussed. These papers represent the result of a year's work on the part of committees and individuals. Among the subjects to be touched on are the electrification of steam railroads, the interconnection of transmission lines of electrical energy producing companies so that production capacity may be maintained at a maximum, and the development of all available hydroelectric energy as rapidly as construction can be financed.

In connection with the electrification of steam railroads a paper will be read on "Fuel Prices and Railroad Operation," by J. E. Woodbridge, consulting engineer, San Francisco, Cal., in which he will point out that the scarcity and high price of fuel oil will soon compel the electrification of all California railroads and that the same will in the near future apply to all oil-burning railroads and in a comparatively short time to all railroads now using coal as a fuel.

Report on Prime Movers Will Show New Developments.

Another report of great importance, and one rather closely allied with fuel conservation, will be given by the committee on prime movers. This report will be one of the longest submitted to the convention, covering 129 pages and containing close to 100,000 words. Every angle and development of prime moving machinery during the past year will be discussed in detail in the report. Likewise the reports of the committees on underground and overhead systems will come in for considerable discussion.

For the first time in the history of the association men connected with state public utility commissions will make addresses in the general meetings. Carl D. Jackson, chairman of the Wisconsin Railroad Commission, will make an address on the "Trend of Regulation," and E. O. Edgerton, president of the California Railroad Commission, is scheduled for an address on the subject, "Reward for Efficiency."

Electric furnaces, which in the past year have come more and more into central-station notice as a load factor, the energy consumption for 1918 representing a total of 300,000,000 kw-hrs., will be discussed in the report of the electric steel furnace division of the commercial section and will also be the subject of a special paper, "The Use of Central-Station Power in Electric Furnaces," by Robert M. Keeney, director of the department of metallurgical research, Colorado School of Mines, Golden, Colo.

Delegates Will Discuss Plans for "Customer Ownership."

In view of the trend of many companies toward the "customer ownership" plan, the report of the committee on the sale of company securities to customers and resident citizens will be of interest to the delegates. The needs of the nation's utilities, excluding railroads, is $800,000,000 for 1920, and upwards of $100,000,000 has already been obtained by central-station companies from their customers through the sale of stock and bonds, the cost of obtaining which was much less than under the underwriting method.

Among other papers of interest to be presented at the general sessions will be "Electric Machinery for All Handling—An Opportunity," by Zenas W. Carter, secretary of the Material Handling Machinery Manufacturers Association; "The Work of the Society for Electrical Development" by J. M. Wakeman, general manager of the society, and a paper on "Service," by S. M. Kennedy, general agent of the Southern California Edison Co.

In addition to the important papers and reports submitted at the general sessions there will be equally important ones taken up and discussed at the various section meetings, which will be held on Wednesday, Thursday and Friday afternoons. The only evening business session will be held Thursday, when the public policy committee, headed by John A. Britton, vice-president and general manager of the Pacific Gas & Electric Co., will make its report.

At the first general session a committee will be named to act on the proposed amendments to the constitution of the association having to do with the reorganization of the association. These amendments will make it possible to form and give power to the twelve geographic divisions into which it is proposed to divide the United States for the purpose of centralizing the work of the association. The division organizations will hold their own conventions and take up problems peculiar to the territory in which they operate instead of having such matters come up at the annual convention.

Entertainment Committee Has Arranged Long Program.

The entertainment provided for the delegates and guests by the convention committee will be on a par with the convention program and will be full of interesting events each day. Opening the convention Tuesday night will be President Ballard's reception, followed on Wednesday night by a special performance of the California Mission Play. On Wednesday also will take place the special event for the delegates arranged by the motion-picture interests of Los Angeles.

On Friday night the Pacific Coast Section of the N. E. L. A. will give the delegates a "big night," details of which have been carefully withheld by W. L. Frost, chairman of the entertainment committee.

The Keynote of the Convention

By President R. H. Ballard

One earnest co-operative endeavor to conserve the forces of nature, that we may make them increase the production of the earth, impresses me as the great central purpose of our industry, as it will be represented at the Pasadena convention of the National Electric Light Association.

Paramount in carrying out this program is the development of all of the hydroelectric energy as rapidly as construction can be financed, the interconnection of the lines of power generating companies, the application of all modern methods for making the generation of electricity by steam produce the highest potentiality for the amount of fuel consumed, and the electrification of steam railroads.

If our deliberations advance this work, our convention will make electrical and economic history.

Presidents of Geographic Sections Review Activities in Various States

Statements Embodying Brief Sketches of Past and Present Conditions, and Business Outlook for the Central-Station Industry

PENNSYLVANIA ASSOCIATION.

By W. R. Kenney,

President, Pennsylvania Electric Association.

Marked interest was shown by members in meetings, exhibits and other affairs at the annual convention of the Pennsylvania Association last fall. One feature of particular interest in the Pennsylvania field is the work carried on through subdivisions of the state association, termed the state geographic sections, as opposed to the national geographic sections. The state is divided into eastern, western and central sections and each holds a monthly meeting, thus bringing together the neighboring utilities whose problems are often very similar on account of similar local conditions.

These meetings might be properly termed interim sessions between the annual state conventions. They have brought the association members in remarkably close touch with one another, and through them it has been possible to discuss the papers and subjects more intimately and extensively than is usually permitted at annual conventions. It is felt that the work carried on in this way is now being reflected in the personnel of the various member companies who have taken active part in these sectional meetings.

Another interesting feature developed as the result of the holding of the sectional meetings in the large cities of the state has been the possibility of obtaining prominent speakers to address the gathering at luncheon. In this way the members have obtained enlightenment on some of the entangling problems of the day.

WISCONSIN ASSOCIATION ACTIVITIES

By W. C. Lounsbury,

President, Wisconsin Electrical Association.

The Committee on Rural Line Extensions, which made such an excellent report at the last annual convention of the Wisconsin Electrical Association, has been renewed and is already actively at work. It proposes to carry out during the year the suggestions made by the members in the report. The members will keep a careful record of costs of rural extensions and the revenue received from them. At the end of the year a considerable amount of valuable data will have accumulated and this will appear in the next annual report of the committee.

Recently the Railroad Commission of Wisconsin held a hearing on the matter of railroad and street car crossings. This brought before the Wisconsin association the work possible for an active committee of the association, which has been appointed. This committee will co-operate with a similar committee from the steam railroads, and, with the chief engineer of the Railroad Commission, will, it is hoped, be able to make a report which will be of considerable value and will assemble much data of interest concerning this question.

Two meetings have been held by the executive committee of the Wisconsin association since the convention in March, principally for the purpose of discussing the question of publicity. At the second conference a representative from telephone interests was present. B. J. Mullaney, of the Illinois Committee of Public Information, was also present and discussed the work done by that committee in Illinois. The Wisconsin Electrical Association has at this time the matter of a program for this state similar to that of the Illinois committee well under way, and will very shortly be able to announce a representative executive committee combining the street railway, electric light and power, and telephone and gas interests of the state, all joined in a campaign of publicity and education which will place before the people of the state facts concerning public utilities.

This association is a geographic section of the National Electric Light Association and, at its annual convention in March, enthusiastically received the plan of M. H. Aylesworth, executive manager of the N. E. L. A., for affiliation in a broader division including the states of Michigan, Illinois, Indiana and Wisconsin, which will comprise the Great Lakes division. It is felt that such affiliation will both strengthen the state association and bring the N. E. L. A. closer to its membership.

DEVELOPMENTS IN MICHIGAN.

By W. M. Lewis,

President, Michigan Section, N. E. L. A.

In Michigan there are 95 privately owned central-station companies and 72 municipal light and power plants. The greater portion of the area of the state electrically served is served by the Consumers Power Co. and the Detroit Edison Co. The lines of the former extend from Bay City, Grand Rapids and Muskegon on the north, and Jackson, Battle Creek and Kalamazoo on the south, serving most of the territory in between. The Detroit Edison Co. distributes over an area within a radius of 50 miles about Detroit. The other companies serve smaller areas and operate on a much less extensive scale.

Metropolitan centers in Michigan have prospered largely through the automotive industry and allied concerns. These factories experienced an unprecedented development and their expansion has been enormous. So rapid was their growth that their isolated plants ceased to be adequate and were rapidly discontinued. The central-station companies were called upon to serve and make the necessary extensions to plants and lines. These problems of expansion were readily solved, but not without difficulty in the securing of necessary equipment in a market of high demand and attendant complications of selling securities in a market where industrials were offering high speculative returns.

Operating problems, such as securing an adequate supply of fuel, were made more complex by the diversion of coal by the Railroad Administration during the miners' strike. Michigan utility companies have passed through these periods safely, but not without the exertion of energy to avoid a complete suspension of operation.

As the available water-power supply has been developed to 75% of its possibility, Michigan must depend upon coal for generating purposes more in the future than in the past. The railroads of the state are very efficient and the movement of all commodities has invariably been at a maximum. However, the initial and intermediate coal carrying roads have not been able to properly supply the needed fuel. If the growing needs of the community are filled, a greater supply of fuel must be obtained.

Michigan is fortunate in its geographic situation, lying in the greatest food and ore producing area of the country and having the waterways of the Great Lakes available for transportation. The state must share in the general prosperity of the country at large, and as the public utilites are so closely interwoven with industrial intercourse, the electric light and power companies will profit thereby.

ACTIVE YEAR IN IOWA SECTION.

By O. H. Simonds,

President, Iowa Section, N. E. L. A.

The Iowa section has had a most active year, the five executive committee meetings which were called being well attended. Of the various subjects under discussion, perhaps the most important were consideration of the new Middle West geographic section of the N. E. L. A., membership in which was applied for in January; stimulating interest in the formation of an

Iowa committee on public utility information, the organization of which is now in the hands of a committee and which, it is hoped, will be well under way by midsummer; and the investigations by the Iowa farm line committee as to the best and most proper methods for central-station companies to employ in serving farmers, this committee having the co-operation of the Iowa State College, and whose report will be invaluable for the central-station companies as well as to the farmers in this important service development.

Individually all member companies reported unprecedented increase in gross business, which unfortunately, is not immediately reflected in net earnings, due to the ever-present delay in getting commensurate relief in electric rates to vie with increase in cost. Plant capacity is being crowded in nearly every instance, and the problem of plant extensions under present conditions of high cost and high money rates is acute.

All member companies report greater consumption of electricity per consumer, and likewise per horsepower of motors connected. The use of electric appliances in the home is increasing most rapidly and the public is gradually appreciating that its monthly electric bill is one of the very small items in monthly expense. As a result electricity is being more liberally used.

The 1920 convention of the Iowa section will again be held at Colfax Springs, the dates selected being June 23-25. There will be no distractions to keep those in attendance from the meetings, thus resulting in a much greater interest in the various papers presented.

NEW ENGLAND SENDS GREETINGS.

By C. R. Hayes,

President, New England Section, N. E. L. A.

New England section is one of the first geographic sections organized in the N. E. L. A. and it is in a steadily growing, healthy condition. There are 1200 members, of which 245 have been added in the past four months. Seven standing committees cover the subjects of advertising, accident prevention, accounting, commercial activities, electric vehicles, public policy, and membership, and in each of these fields the members have undertaken much.

The underlying motive of these committees is "service to our member companies." For instance, the commercial section committee has, in developing its program for the year, through the personnel of the committee, made personal calls upon practically all member companies in New England. The purpose has been not only to give out information on matters of common interest, but to secure data relative to interesting and timely developments in the particular territories visited.

In March a most successful question-box conference served as a means to obtain expression of the members upon problems of the moment. This conference covered a full day, and one outstanding feature was the lively interest in the problem of the relation of the central-station company to the contractor. In New England it can undoubtedly be said that this is no longer a problem. There are many influences at work to bring about a close relationship between the central-station companies and electrical contractors. Contrac-

Each month in Boston there is held a so-called electrical luncheon at which the electrical men of New England gather informally for an interchange of ideas of mutual interest. Good speakers bring to these meetings ideas applicable to the particular problems of the central-station industry. At the last luncheon M. H. Aylesworth, executive manager of the N. E. L. A., disclosed the proposed plan for the reorganization of the national association. It is the general feeling of the New England members that the association is fortunate in having as executive manager a man of the broad training and experience in utility affairs as that possessed by Mr. Aylesworth. The New England section proposes to advance the reorganization plan of the association because it is felt that this plan as a whole should be thoroughly supported throughout the country if the industry is to fulfill its obligations in all respects. The N. E. L. A. as now organized can be of untold benefit to the member companies and it is necessary that the support of every member company be forthcoming.

New England will be well represented at the Pasadena convention. New England central-station men are also looking forward to their own convention Sept. 13-16. It may be that a delegation from the Pacific Coast can be prevailed upon to come to New England at that time, and it will be most cordially welcomed.

FROM THE NORTHWEST SECTION.

By John B. Fisken,

President, Northwest Electric Light and Power Association.

Central-station companies in the Northwest section are all generally prosperous and much new business is being developed. In some localities there has been developed abundance of power, while in others there is reported a shortage. The addition of Utah recently to the Northwest section has given that section a great increase in strength.

All the section committees are actively engaged in doing good work. Co-operation with the contractors and dealers is being actively forwarded by the central-station companies in this section.

MISSISSIPPI ELECTRIC ASSOCIATION.

By R. B. Claggett,

President, Mississippi Electric Association.

The Mississippi Electric Association has for a number of years constituted a unit of the N. E. L. A. At the present time, however, its membership is favorably disposed toward the plan to join with Texas, Louisiana, Arkansas and Oklahoma in the formation of the Southwestern division. There are a great many companies in that particular section that are similar in size to those in Mississippi, and it is generally felt that the companies in the latter state will greatly benefit by affiliation with companies in the other states comprising this section.

CALIFORNIA'S WELCOME.

By Gov. William D. Stephens.

California cordially welcomes the central-station men. The people of our state realize the need of electrical development, and the convention at Pasadena will receive much attention.

Hearty wishes are extended for a pleasant trip and successful session.

Southern California Edison Co.'s Power System

General Outline of Power Plants, Water-Storage Facilities, Transmission Lines and Distribution System, with Details of Important Construction, Operating and Service Features

By W. A. SCOTT

The extensive properties under Southern California Edison control comprise its original holdings, those of the Pacific Light & Power Corp., a consolidation of which was effected in 1917, and the several plants of the Mt. Whitney Power & Electric Co., until recently controlled as a subsidiary, but now forming a part of the main system.

The company's energy-producing capacity at this date amounts to 203,000 kw., of which 117,000 kw. is furnished by hydroelectric stations and 86,000 kw. by steam-driven generators. One 32,000-kw. hydroelectric plant is under construction and a new 16,000-kw. unit is being installed at one of the existing hydroelectric stations. This work is to be completed before the close of 1920, thus adding 48,000 kw. to the 203,000 kw. of capacity now available, raising the total to 251,000 kw. To the above steam capacity, however, should be added about 10,000 kw., generated at four auxiliary plants, located at Los Angeles, Oxnard, Visalia and Tulare.

Counting the 1920 development, to become an available part of the system within a few months, the company's generating stations may be grouped as follows: Those north of Tehachepi pass, in San Joaquin valley, consist of three plants on Kern river, that being an important stream at the upper, or southern, end of the San Joaquin valley; two stations on Big creek, that stream flowing into the San Joaquin river at a point about 40 miles northeast of Fresno, and four small plants of the Mt. Whitney development, in Tulare county, consisting of three on Kaweah and one on Tule river.

The Kern River development consists of Kern River No. 1, the plant situated farthest downstream and about 15 miles northeast of Bakersfield, which is equipped with four 5000-kw. hydroelectric units; Borel plant, 16 miles upstream from Kern River No. 1, has five 2000-kw. units; Kern River No. 3 occupies a site about 15 miles upstream from Borel plant, and is under construction, the completion of which will be reached before the end of 1920. This plant is being equipped with two 16,000-kw. units. More spe-

View of Kern River Power Plant No. 1 of Southern California Edison Co.

cific data with reference to this and the other two Kern river plants are given under appropriate headings.

The Big Creek development is, no doubt, the most important in the company's system, by reason of its present and prospective water-storage resources. Huntington lake, under existing development, provides storage of 88,000 acre-ft. of water for Big Creek stations No. 1 and No. 2. Big Creek No. 1 is equipped with two hydroelectric units of 16,000-kw. capacity each and Big Creek No. 2 has two units of like capacity, with a third unit of 16,000-kw. capacity being installed.

The four hydroelectric plants of the Mt. Whitney group, situated in the foothills, half way between Kern river and Big creek, are equipped for a combined maximum output of 9000 kw., these being supplemented, during low-water periods, by the delivery of energy from the main Edison stations, and by the small steam-electric plants at Visalia and Tulare.

A summary of this company's hydroelectric stations in San Joaquin valley follows:

Kern River No. 1	20,000 kw.
Borel plant, Kern river	10,000 kw.
Kern River No. 3, being built	32 000 kw.
Big Creek No. 1	32,000 kw.
Big Creek No. 2, including new unit	48,000 kw.
Mt. Whitney group	9,000 kw.
Total	151,000 kw.

The remaining 14,000 kw. of the company's 165,000 kw. of hydroelectric capacity is furnished by ten smaller plants south of Tehachepi pass, which are known as the "East End" group, situated in the vicinity of San Bernardino.

The steam-electric capacity of 86,000 kw. is provided by two stations, situated on the beach, in the vicinity of Los Angeles. One of these is at Long Beach and is equipped for an output of 47,000 kw.; the other plant, at Redondo, is equipped for an output of 39,000 kw.

The base water-power stations of the system are those on Kern river, those of the "East End" and Mt. Whitney groups, none of which are supplied from reservoir reserves. The two Big Creek stations have large reservior supplies from an extensive watershed back of them. The importance of that drainage area and the possibilities of future storage will be shown in connection with the description of the Big Creek development.

All the plants of the Southern California Edison Co. generate energy at the frequency of 50 cycles, except the four small stations of the Mt. Whitney group, which generate at 60 cycles. Those of the latter group have a maximum output of 9000 kw., but during the height of the 1919 pumping season there were demands for a load of 25,000 kw., all of which was required at 60 cycles. The excess over and above what the Mt. Whitney plants can furnish must be supplied from the 50-cycle stations on Kern river and Big creek. This is accomplished by means of a 15,000-kw. frequency changer, installed in Vestal substation at Richgrove, 23 miles north of Bakersfield. This machine connects through a bank of transformers with the Big Creek high-tension lines that extend to Los Angeles. The Vestal substation is being equipped as the terminal of the transmission lines from the new Kern River No. 3 power station. In order to facilitate the delivery of energy from the main lines to those of the Mt. Whitney group of different frequency, it was decided to so equip the new Kern River No. 3 station as to make the two units effective in generating, alternately, at either 50 or 60 cycles. In this plant there are being

Diversion Dam and Intake to Kern River Plant No. 3 of Southern California Edison Co.

installed two generators, each to be driven by a hydraulic turbine having interchangeable runners and distributers. It is calculated that, for instance, the 50-cycle runner may be removed and replaced by the 60-cycle runner within 24 hours. Under this arrangement, either one or both units may directly serve a 50-cycle system a part of the season and a 60-cycle system during the other part. That is, the Mt. Whitney 60-cycle load may be supplied directly from the plant at Kern River No. 3, operating at 60 cycles, or through the frequency changer, receiving 50-cycle energy from the Big Creek transmission lines. Incidentally, it may be stated that this company supplies some energy to the 60-cycle system of the San Joaquin Light & Power Co. of Fresno.

Kern River No. 1 Hydroelectric Plant.

The hydroelectric station known as Kern River No. 1 was completed in 1907, and some facts relating to construction and equipment will be of interest, because of the problems met in constructing a conduit of a length of 9 mi. through a series of rock tunnels from the diversion dam to a forebay, and the installation of a pressure main from the forebay through an inclined tunnel to the power house.

The diversion dam, of the overflow type, has a length of 203 ft., a height of 20 ft. above mean water level, and a base thickness of 53 ft. The intake section of the conduit was enlarged to a width of 16.5 ft., the controlling gates being operated by hydraulic cylinders. There is a 365-ft. drainage tunnel passing from the bottom of the reservoir through bedrock below the intake of the conduit, the flow through which is controlled by hydraulic-operated gates. The drainage tunnel serves to wash out the silt and sand from the bed of the reservoir. There are 19 tunnels of a combined length of 42,910 ft. between the diversion intake and the forebay. Those tunnels, which were concrete lined, were cut 7 ft. wide and 7.5 ft. in height from base to spring line of arch, with a height of 9 ft. at the center.

They have a grade of 7.92 ft. to the mile, and have a carrying capacity of 470 cu. ft. per sec.

The flume and conduit construction between tunnels was an important feature. A wooden flume was constructed between tunnels No. 1 and No. 2, and there was similar construction in spanning several side canyons of a total length of about 1500 ft. In crossing other similar canyons, the flumes were built of structural steel and concrete. In those cases, there are concrete piers supporting 15-in. steel girders 8 to 10 in. apart. These carry 9-in. steel crossbeams which support the steel framework for bottom and sides of the flume. The concrete conduits connecting several tunnels were built of a size similar to that of the tunnels. There are 8 conduits of that class, with a total length of 398 ft.

The forebay, at the terminal of the gravity conduit that feeds into the pressure main, consists of an excavated chamber, 30 by 42 ft., of a depth of 8 ft., the chamber being heavily concrete lined on account of the shattered formation. The overflow from the forebay is carried by a flume into Kern river.

The pressure main, of a length of 1700 ft., was cut at an inclination through the mountain, and given a sheet-steel lining. Part of the way it dips at an angle of 45 deg., making three vertical curves between the forebay and the power house level. In diameter this main tapers from 20 ft. to 10 ft. at the forebay entrance, and then diminishes to 7.5 ft. to the point where it emerges from the mountain, and from that point to the power house it has a diameter of 5.25 ft. The section of the latter diameter connects with the steel pipes leading to the waterwheels, the flow from the pressure main to those pipes being controlled by two 28-in. gate valves for each pipe.

The power house contains four 5000-kw. generators, each driven by two impulse, overhung waterwheels, operating under a head of 878 ft., there being one wheel on each end of the generator shaft. These turbines have a speed of 250 r.p.m., and a capacity of 10,750 hp. each. The generators operate at 2300 volts, 3 phase, 50 cycles. There are four banks of transformers, each bank containing three 1667-kw. 50-cycle transformers, by which the generator voltage is stepped up to 75,000 volts for line transmission to Los Angeles, a distance of 117 miles. This is a double-circuit line of No. 0000 copper conductors carried on steel towers.

Inverted Siphon in Conduit Line to Kern River Plant No. 3.

Kern River No. 3 Hydroelectric Plant.

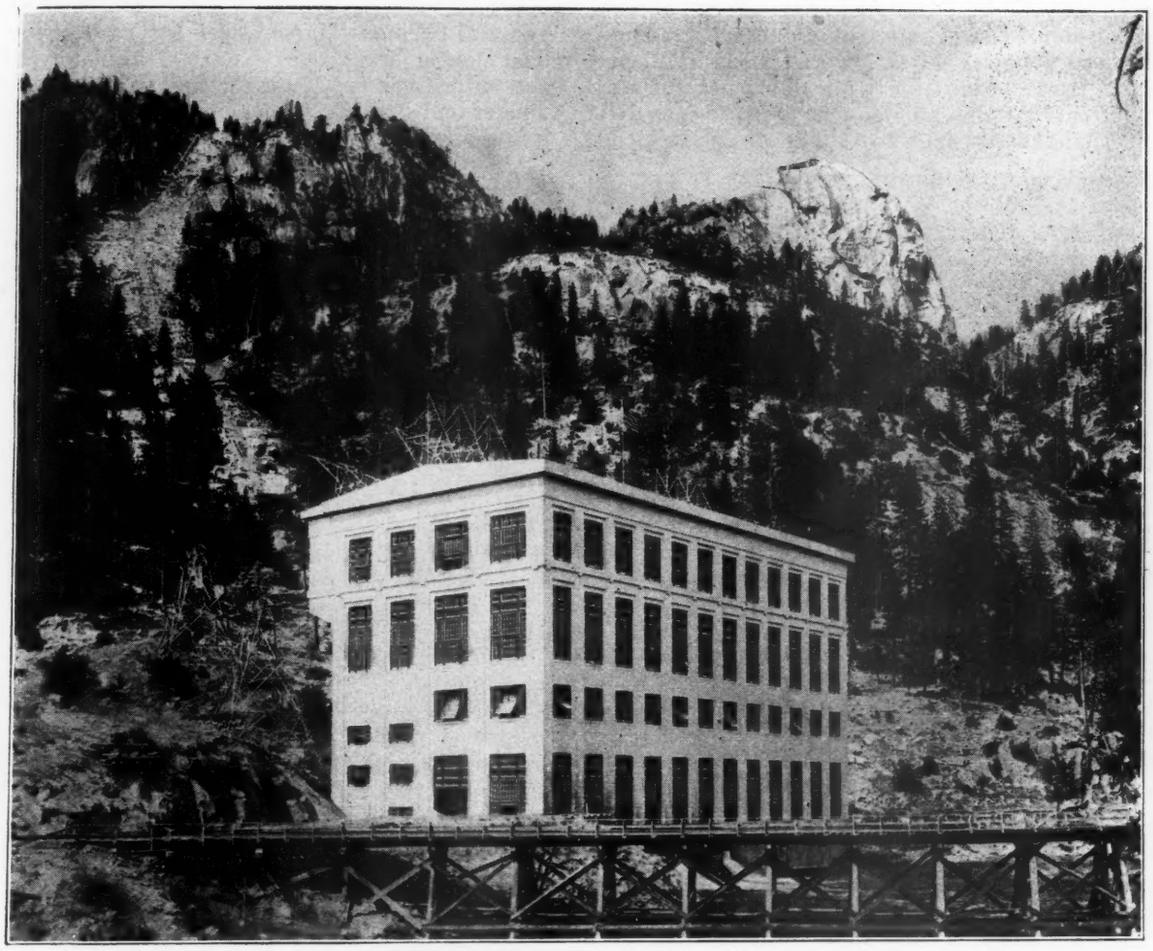
The initial phase of this development was the construction of a diversion dam on Kern river at a point of 12.5 miles upstream from the power house site. This work has been completed, and, as already stated, the other construction and the installation of equipment are expected to be completed within the next six months. The conduit leading from the diversion dam to forebay, consists of 0.5 mi. of flume and canal, which is followed by 12 mi. of tunnel through solid rock, with intermediate short spans of flume and pipe for crossing canyons. The water will be conducted from the forebay to the turbines through two steel pressure pipes, the upper sections of the pipes to be of riveted steel, 6 ft. in diameter, and the lower sections of lap-welded steel, 5 ft. in diameter.

The two generating units being installed consist of two 22,500-hp. hydraulic turbines of the Francis type, each direct-connected to a 16,000-kw. generator of the vertical type, the turbines to operate under an effective head of 800 ft. Each turbine is being provided with two runners, which will be interchangeable; one runner will be for driving the generator to produce energy at 50 cycles, and the other for 60-cycle production. The conditions that required a generating station that could be operated alternately at those two different frequencies have already been explained. The shaft for each unit has a diameter of 14 ins. and is bored through the center; the runner and distributer, it is planned, may be removed as a unit when it is required to make the change from one speed to another.

The vertical generators have thrust bearings at the upper end of the shaft, and three guide bearings, one above and two below the generator. Besides having one exciter mounted on the upper end of the generator shaft, there is an auxiliary exciter driven by an induction motor. It is planned to have no low-tension switches and buses between generators and transformers, but the energy at the generator voltage will be conducted direct to the transformers. The energy generated at Kern River plant No. 3 will be transmitted 45 mi. to Vestal substation over a double-circuit steel-tower line at 70,000 volts.

Big Creek Development.

Huntington lake receives the waters of Big creek, having a drainage area of 79 sq. mi. The lake has a storage capacity of 88,000 acre-ft., which is equivalent to the production of energy amounting to 275,000,000 kw-hrs. The two existing Big Creek hydroelectric stations have a total production of 346,000,000 kw-hrs. per year,



Big Creek Power House No. 1 of the Southern California Edison Co.—Capacity 32,000 Kw.—Operating Under Head of Approximately 2070 Ft.

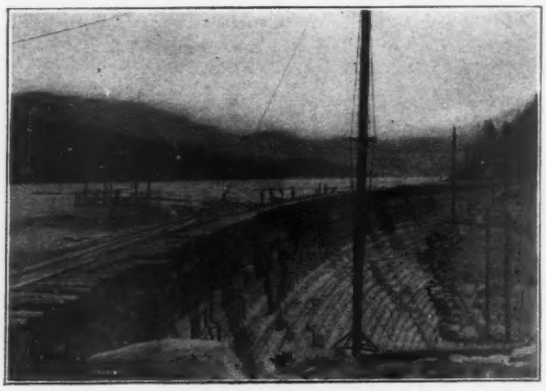
which includes the reservoir storage and stream flow. The storage lake was formed by the construction of three concrete dams, and is at an elevation of about 7000 ft. This locality is 241 mi. north of Los Angeles, requiring a double-circuit high-tension line of that length for the transmission of energy to the receiving station near that city.

Big Creek plant No. 1 contains two General Electric generators of the capacity of 16,000 kw. each. In each unit the generator is direct-connected to and driven by an Allis-Chalmers double-runner, tangential waterwheel of 22,500-hp. capacity, operating under a static head of 2100 ft. The generators, which run on horizontal shafts at a speed of 375 r.p.m., operate at 6600 volts, 3 phase, 50 cycles. The equipment includes two main exciter sets of 150 kw., 250 volts each, one being connected to a waterwheel at one end and a 200-hp. motor at the other end; the second is operated by a direct-connected waterwheel. There are seven single-phase transformers, stepping up the voltage from 6600 to 150,000 volts for the high-tension line.

Water is conducted from the lake to the turbines through a rock tunnel and steel pipes, which may be described as follows: From the intake at elevation 6950 ft. it flows through 3546 ft. of tunnel of the diameter of 10.5 ft., that section having the capacity of 800 to 900 sec-ft. It passes thence through 6445 ft. of 84-in. steel pipe of the carrying capacity of 560 sec-ft. From the lower end of the 84-in. line at elevation 6769 ft., the stream divides and feeds into two parallel steel pipes 3595 ft. long, each of a diameter grading from 42 to 36 ins. Each of those lines discharges into two 26-in. steel penstocks leading to the waterwheels. The 3546 ft. of 84-in. pipe makes a descent of 181 ft. to the point where it feeds into the two 42-in. lines, and from the intake of the latter lines to the waterwheels, there is a descent of 950 ft. This, with the grade of the tunnel section, gives an effective head of 2070 ft.

The tailwater passes from plant No. 1 into a forebay formed by dam No. 4, at which the top elevation of flashboards is 4810 ft. and that of the base of dam is 4788 ft. The conduit leading from this forebay to plant No. 2 has a length of about 26,200 ft., and in that distance makes a descent of 1848 ft. The upper section of this conduit consists of 21,287 ft. of rock tunnel, 12 ft. in diameter and having the capacity of 700 sec-ft. A concrete surge tank at the discharge end of this tunnel has a diameter of 32 ft. and a height of 104 ft. Water then flows from the surge tank through 255 ft. of 108-in. riveted-steel pipe, in practically a horizontal position. Close to the lower end of this section is a small standpipe which serves to relieve the pressure, where the 108-in. pipe discharges through 54-in. valves into two parallel lines of 44-in. riveted-steel pipe of a length of 613.75 ft. This twin line of riveted-steel pipe is joined on

to lap-welded steel pipes of diameters grading down as follows: First, 3070 ft. of 42-in., then 24.78 ft. of 40-in., 160 ft. of 38-in. and 391 ft. of 36-in. At this point, each 36-in. section divides and feeds into two lines of lap-welded



Dam. No. 1 at Huntington Lake Reservoir, Showing Intake Tower.

pipe, by which the water at 1900-ft. head is conducted to the waterwheels. The last pipe section for each unit comprises twin lines, consisting in each case of 112.58 ft. of 26-in. and 56.8 ft. of 24-in. pipes.

The station equipment in plant No. 2 is of same capacity as that in plant No. 1, as regards the two original units. Those units consist of two Westinghouse generators, horizontal type, each direct-connected to and driven by an Allis-Chalmers double-runner, tangential waterwheel, operating under a maximum head of 1900 ft. The third unit, in process of installation, is being equipped with a Westinghouse 16,000-kw. generator, direct-connected to and driven by a Pelton impulse wheel of 22,500-hp. capacity. All generators in the two Big Creek stations operate at 6600 volts, 3 phase, 50 cycles. Plant No. 1 is equipped with seven General Electric single-phase transformers of 5833-kw. capacity each, and plant No. 2 has Westinghouse transformers of the same number and of like capacity. In both plants the generator voltage of 6600 is stepped up to 150,000 volts for transmission to Los Angeles.

Big Creek Transmission Lines.

There are two steel-tower lines carrying one circuit each, extending from Big Creek power station No. 1 to the Eagle Rock substation, near Los Angeles, a distance of about 240 mi., with a tap line of 0.74 mi. from station No. 1 to station No. 2. The capacity of each 150,000-volt circuit is 57,500 kw. at 85% power-factor. The tower lines have a right-of-way of 150 ft., there being a separation of 82 ft. between tower-line centers. There are 1694 steel towers in each line, or an average of 7.08 to the mile. The normal spacing in the valley where no sleet occurs is 660 ft.; in valley sections of sleet occurrence, 550 ft.; maximum span on standard towers, 1822 ft., with maximum spans on special towers of 2871 ft. at Sunland and 2776 at Kings river. Each tower line carries three aluminum conductors with steel cores, the arrangement in the horizontal plane being shown in one of the illustrations. There is one ground wire of ½-in. 7-strand Siemens-Martin steel for each tower. The double line requires 190,000 insulators of the suspension type, these being 10 ins. in diameter and 5.75 ins. from center to center of insulators.

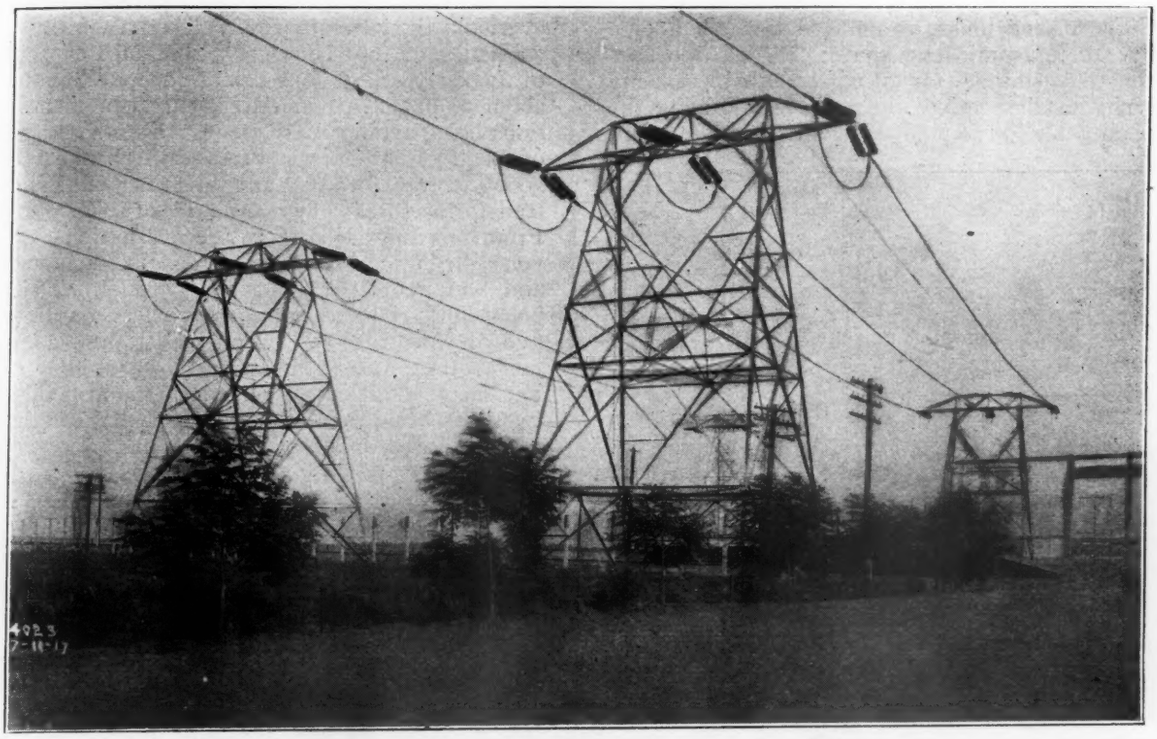
Eagle Rock Substation.

The equipment at this substation, which constitutes the receiving station at the Los Angeles end of the Big Creek transmission lines, may properly be referred to here. The transformers are delta connected with the incoming 150,000-volt lines. There are six of 11,500-kv-a. capacity each, delivering energy at 60,000 volts, and six of 4500-kv-a. capacity each, delivering energy at 15,000 volts, making a total transformer capacity of 96,000 kv-a. The station contains two 15,000-kv-a. synchronous condensers, with a new condenser of 30,000-kv-a. capacity being installed on the 60,000-volt side. To provide substation capacity for distributing the increased output to be made available by the installation of the new 16,000-kw. unit at Big Creek No. 2, and by the installation of two 16,000-kw. units at Kern River No. 3, the two banks of three 4500-kv-a. transformers at Eagle Rock, on the 60,000-volt side, are being removed and replaced by two banks of three 11,500-kv-a. transformers. In order to handle the increased load on the Big Creek 150,000-volt power lines, the additional condenser of 30,000-kv-a. capacity was required, and it is to be supplied from the 60,000-volt bus through three 10,000-kv-a. transformers, with a ratio of 60,000 to 6600 volts. The result of those changes will be to give this substation two 15,000-kv-a. condensers and one of 30,000-kv-a. capacity; six transformers of 4500 kv-a. capacity each on the 15,000-volt side, and six of 11,500 kv-a. capacity each on the 60,000-volt side, so increasing the transformer capacity that the substation may distribute 96,000 kv-a. in energy, instead of 54,000 kv-a. as heretofore.

Reverting to the Big Creek region, the subject should not be dismissed without giving a brief outline of the prospective development of great

Interior of Big Creek Power House No. 1.

potentiality for which the Southern California Edison Co. has some well-matured plans. Those plans contemplate the construction of six hydro-electric plants, giving an ultimate capacity of 862,000 hp. for the entire Big Creek project. That region has storage possibilities greatly exceeding those presented by Huntington lake under existing development. First, the water



Big Creek 150,000-Volt Transmission Line, Showing Dead-End Towers in the Foreground and Suspension Towers in the Background.

of Shaver lake, on Stevenson creek, at an elevation of 5400 ft., is now impounded by an earth dam, and by the construction of a concrete dam it is shown that a storage basin of 146,000 acre-ft. may be created. A part of the plan is to divert the surplus water from Huntington to Shaver lake by a tunnel and pipe line, developing power for plant No. 5 between the two. The outlet from Shaver lake would be into a conduit leading to plant No. 2, and from the tail water of that plant through a tunnel line to the site of proposed plant No. 8.

It is proposed to increase greatly the drainage area supplying Huntington lake by cutting a tunnel of 1000 sec-ft., 11 mi. long, from the latter to Florence lake, which is fed by the headwaters of the south fork of the San Joaquin river. This would result in increasing the area of the Huntington lake watershed from 79 to 393 sq.. mi. The result would be to make practicable much greater capacities at Big Creek plants Nos. 1 and 2, and to supply additional plants farther down the river.

Plans also contemplate the drainage of Vermilion lake into Florence lake, and thus add to the volume of water turned toward Huntington lake. Vermilion is on another branch of the south fork of the San Joaquin. Other plans would provide for directing a large area of middle fork drainage to proposed power sites on the main San Joaquin, above the point where Big creek enters the main river.

It is understood that the first new plant to be built probably will be at power site No. 8 on the San Joaquin river, at the point where Big creek flows into it. The plan for this provides for running the tail water at Big Creek plant No. 2 through a tunnel and then dropping it 700 ft. through a steel pipe. The initial capacity of the proposed plant No. 8 would be 35,000 hp., with a prospective ultimate capacity of 117,000 hp. Power site No. 6 on the main river, upstream from No. 8, is to be developed for a capacity of 147,000 hp. under 1650 ft. head. Power site No. 7, still farther upstream, has the prospective potentiality of a 1900-ft. head, and an ultimate capacity of 40,000 hp. by utilizing the flow of the middle fork.

In addition to the above defined watershed of the area of about 393 sq. mi., the other watersheds within the scope of proposed Big Creek development will give the entire project a drainage area of 1266 sq. mi.

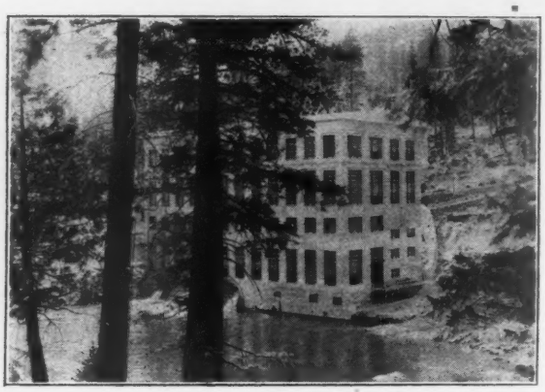
Long Beach Steam-Electric Station.

This plant, which is among the most modern of steam-electric stations on the Pacific Coast, is situated on Long Beach harbor, and is housed in a concrete structure advantageously designed for large installations of this character. The grounds in front are made attractive with lawn grass, trees and flowers. Facilities for the convenience and comfort of employes are of the best.

The station contains three units. No. 1 unit consists of 8 Sterling boilers of 777 hp. each, and one General Electric 12,000-kw. turbogenerator of the Curtis vertical type. No. 2 unit contains 8 Stirling boilers of the same capacity, and a turbogenerator of a type similar to that of No. 1, but of the capacity of 15,000 kw. No. 3 unit comprises 8 Stirling boilers, each of 850-hp. capacity, and a 20,000-kw. turbogenerator of same type as the other two. The boilers all operate at 225 lbs. pressure and at 125 deg. superheat. The boilers of No. 3 unit are equipped with Sturtevant economizers. All boilers are fired with fuel oil, for which Hammel burners are used.

The fuel oil, supplied from the Union Oil

Co.'s storage tanks, is pumped through a pipe line 10 to 15 mi. long and discharged into four concrete storage tanks of 8000-bbl. capacity each, installed below the surface adjoining the plant. The oil is pumped from these into 4 oil-



View of Big Creek Power House No. 2.

feed or burning tanks of 2000-bbl. capacity each, also situated below the ground surface. The fuel is pumped from the latter tanks directly into the boiler furnaces at a pressure of 50 lbs., and at a temperature of 130 to 140 deg. F.

The boilers are all provided with flow meters, CO_2 recorders, feed-water meters and measuring devices that show the quantity of oil being consumed. In No. 3 unit the condensate from No. 3 turbine is pumped to the hot well, and is pumped thence to the economizer.

The auxiliaries of No. 1 unit are all engine driven, except the exciter set for the generator, which is driven by a steam turbine. The No. 2 unit auxiliaries all have steam-turbine drive, except the step-bearing pumps and the dry vacuum pump, those being operated by reciprocating engines. In No. 3 unit all the auxiliaries are motor-driven, which include the boiler-feed pumps.

No. 1 turbogenerator is equipped with a Wheeler surface condenser with 21,497 sq. ft. of cooling surface, which is supplied with cooling water by a Krogh centrifugal pump of the capacity of 24,000 g.p.m., and driven by a reciprocating engine. No. 2 turbine is also equipped with a Wheeler condenser, with 27,000 sq. ft. of cooling surface, supplied with water by a Wheeler pump of 30,000-g.p.m. capacity, and driven by a Curtis steam turbine. No. 3 turbine unit has an Alberger condenser of 36,000-sq. ft. of cooling surface, and is served by a Byron Jackson centrifugal pump of 40,000 g.p.m. capacity, which is driven by a 400-hp. motor. The dry vacuum pump for each unit relieves the condenser of air that may come in with the water or otherwise.

Ocean water, used for condensation purposes, is brought in by gravity from the harbor through a concrete tunnel of 6 by 6-ft. cross-section, and 400 ft. long. This tunnel delivers the sea water into chambers from which it is pumped to the condensers. The discharge from the cooling surfaces passes through a second concrete tunnel to the ocean in another direction.

The generators are operated at 11,000 volts, 50 cycles, and the main switchboard panels are on a mezzanine floor over the office, and which overlooks the generator floor. The transformers, consisting of four banks of a combined capacity of 47,000 kw., are housed in a concrete building about 50 by 300 ft., and 40 ft. high, the installations being arranged as follows: Two banks are of 2000-kw. transformers; a third bank is of 5000-kw. transformers; and the fourth bank is of transformers of the capacity of 6666 kw. From this substation there are five local 11,000-volt distributing lines to the cities of Long Beach and San Pedro, lines being carried on wooden poles, and four 60,000-volt transmission lines, two of which are carried on steel towers a distance of 25 miles to Newmark, where they tie into the general 60,000-volt system, and the other two lines being carried on wooden poles to other points, where they tie in with other 60,000-volt lines of that system.

Redondo Plant.

The steam-electric power station at Redondo Beach, 20 miles from Los Angeles, has been in service ten years or longer. The equipment is installed in a large concrete structure, the plant having a rated capacity of 39,000 kw. It has a boiler capacity of 21,600 hp., furnished by 18 Babcock & Wilcox and 18 Stirling boilers of 600-hp. capacity each, operating under 200 lbs. pressure and 125 deg. superheat, all using fuel oil under arrangements similar to those at the Long Beach plant.

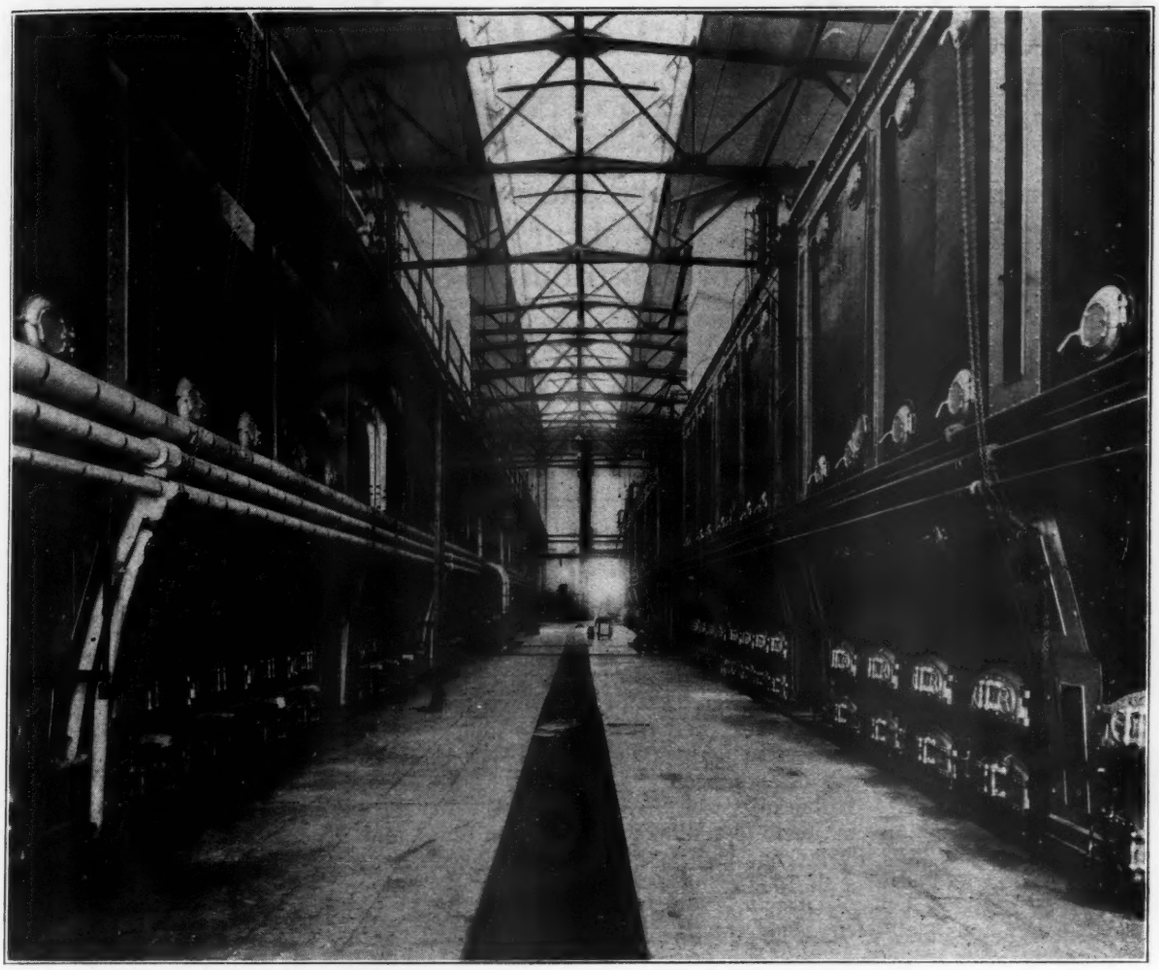
The generating equipment consists of two vertical turbogenerators and three horizontal engine-driven generators. The turbogenerators are of the Curtis vertical type and rated at 12,000 kw. each. The generators operate at 9000 volts, 3 phase, 50 cycles, this voltage being stepped up to 15,000 by transformers, connecting with the 15,000-volt station bus. There are four 15,000-volt railway circuits going out from the plant, which contains three 5000-kw. transformers for stepping up to 66,000 volts, tieing in with the company's transmission system.

The other generators consist of three 5000-kw. machines, operating at 15,000 volts, 3 phase, 50 cycles. Each generator is driven by two direct-connected, horizontal-vertical compound engines

Exterior of Eagle Rock Substation, Showing 150,000-Volt Line and Lightning-Arrester Equipment.

of 3500-hp. capacity each. These engines are the double-acting compound type of the MacIntosh-Seymore make, each being 35 by 70 by 56 ins.

Sea water for condensing purposes is brought in through three steel intake pipes, each 4 ft. in.



Boiler Room in Long Beach Power House of the Southern California Edison Co.—Capacity 65,000 Hp.

diameter. These parallel pipes, which are supported by concrete piers, have a length of 600 ft., the intake ends dipping to a point below water level in the sea, the discharge ends opening into three concrete screen chambers on the shore. By means of an air lift, connected with air compressors, the ocean-water pipes operate as siphons for conducting the water to the screen chambers. There are three centrifugal pumps for delivering cooling water to the condensers, each of which has a cooling surface of 21,000 sq. ft. The discharge of water from the condensers is through a concrete tunnel into the ocean.

Going out from this station are five 15,000-volt lines and one 60,000-volt line, the latter carried on steel towers. The heavy load delivered to the electric railways, from this and other stations, is alternating-current energy, which is converted to direct current by motor-generator sets installed in the substations of the street railway company.

Transmission and Distribution.

The Southern California Edison Co. has on its power system, about 484 mi. of 150,000-volt, single-circuit transmission line, made up of the double steel-tower line between Big creek and Los Angeles. It has 1188 miles of 60,000-volt, single-circuit transmission towers, one part of which is carried on steel towers, and the other part on wooden poles.

Its distributing lines transmit energy at 15,000, 11,000 and 2200 volts. This system is connected on the south with the San Diego Gas & Electric Co.'s 60-cycle system through an Edison company 60,000-volt line, 30 miles long, from Katella substation, near Santa Ana, to San Juan Capistrano, where the Edison company has a 5000-kw. frequency changer.

Connected Power Load.

A compilation of data on power consumption on this company's system for 1919 shows the connected load in the principal industries as follows:

Industries	Connected Load in Hp.
Pumping plants	121,266
Industrial manufacturing	88,356
Ice Making and refrigeration	4,856
Moving pictures	2,336
Cement manufacturing and rock crushing	6,945
Railways, Motive power	99,144
Railways, Industrial	2,997
Canal and harbor dredges	440
Oil wells,—operating and development	4,557
Heating—industrial	1,831
Heating and cooking	21,121
Battery charging	3,817
Other electric corporations for resale	47,995
Municipalities, for resale	2,500
Municipal pumping	8,449
Elevators	2,011
Miscellaneous	31,899
Total hp.	450,315

Electric Power Development in the Pacific Northwest

Principal Hydroelectric and Steam-Electric Plants—Central-Station Construction, Equipment, Operating Features, Transmission Lines and PowerDistribution Systems in that Section

In this review of electric power development in the Pacific Northwest, it will be noted that it relates principally to the vast area of territory drained by the Columbia river and its tributaries, but included in that territory are the great watersheds whose drainage is directly into Puget Sound, Grays Harbor and other Pacific Coast bays. In Oregon, the Willamette, Deschutes, Hood, Umatilla, John Day and Malheur rivers form a part of the Columbia system and drain the northern, central and eastern parts of the state. The southern part is watered by the Umpqua, the Rogue and other streams that empty into the Pacific, and by those which are outlets of the Klamath and Clear lakes, east of the Cascade range. All those rivers and their mountain tributaries are of moment as to existing and future hydroelectric development.

The Columbia's greatest tributary is the Snake river, which rises in the majestic Teton mountains, near Yellowstone Park, coursing its way for a thousand miles through Idaho and forming part of the boundary between that state and Oregon. The Snake and its affluents form the bases of important hydroelectric operations in Idaho, known as the St. Maries, Coeur d'Alene and Kootenai regions, belongs to the headwater systems of the Columbia river. The Coeur d'Alene region, including a river and lake of that name, feeds into the Spokane river, on which are some of the most important water-power developments in the Northwest. The Spokane river flows into the Columbia river. Other tributaries of the upper Columbia in Washington are the Kettle, Similkameen, Okanogan, Methow, Wenatchee and Chelan. The last named is the outlet of Lake Chelan, which forms a storage basin of great future utility. Those streams already have some hydroelectric development to meet demands for lighting, pumping water and for small industries.

A river of importance that issues from the eastern slope of the Cascade range in Washington is the Yakima and its tributaries. It supplies water to a vast irrigated country between Ellensburg and Kennewick and affords some hydroelectric development. The Klickitat and White Salmon, which flow into the Columbia river farther south, are important streams, the latter now having an important hydroelectric plant in the vicinity of Underwood.

The Puget Sound watershed of the Cascade

Hydroelectric Plant at the Casadero Station of the Portland Railway, Light & Power Co.

range is of vast importance on account of the numerous rivers that flow from it into the sound and also by reason of the industries, commerce and heavy population of cities and towns that border this body of water. Such rivers as the Puyallup, White, Green, Cedar, Snoqualmie, Snohomish, Sultan, Skagit and Nooksack each has the requisite volume, head and storage possibilities necessary for power development. Further on in this article it will be shown to what extent such development has already been accomplished. Other rivers, such as the Elwha and Skokomish, which flow into the sound from the Olympic mountains, have a bearing on the supply of power at Port Angeles and Tacoma.

The rivers which flow into Grays Harbor, such as the Chehalis, Wynootche and Wishkah, furnish no hydroelectric development at the present time, though the last two may offer such possibilities. On the Cowlitz river, in southwestern Washington, there are important sites, for which some tentative plans have been made for water storage and hydroelectric power.

Of the twelve or more hydroelectric stations in western and central Montana, two or three are within the scope of Columbia river drainage, and on such streams as Clark's Fork and the Flathead the conditions are favorable for hydroelectric development. The stations in Montana situated east of the continental divide are on the Missouri river and its tributaries, a part of the Mississippi system, though practically a part of the Northwest.

The foregoing gives a brief outline of the river resources of the section under review, from which the deduction may be made that almost any conceivable demand for power that the future can bring may be supplied by hydroelectric stations operating as part of interconnected systems. In the matter descriptive of power plants which follows it will be noted that in every system there are numerous steam-electric stations serving as auxiliary to the hydroelectric plants. The steam plants are essential to tide over possible periods of low water and to answer emergency demands. The availability of an abundance of sawmill refuse for fuel at steam-electric plants greatly reduces fuel costs, especially in cases where the power plant and sawmill are not separated by long distances.

Power Plants of the Portland Railway, Light & Power Co.

The Portland Railway, Light & Power Co. began operations in 1894 under the name of the Portland General Electric Co., building the first unit of its station "B" at the falls of the Willamette at Oregon City. Subsequent installations, in 1897 and 1898, were made at this plant by the company under the present corporate name, and this station as it stands today is equipped as follows: There are twelve 33-cycle generators, having a rating of 450 to 540 kw. each, with a total capacity of 5730 kw. Ten of these are driven by two 42-in. vertical turbines, each one of which is direct connected and the other belted to the generator, the turbines being rated at 1200 hp. each and operating under a head that varies from 10 to 42 ft. There are also two 33-cycle generators of 540 kw. capacity each, driven by two S. Morgan Smith 51-in. horizontal waterwheels, each direct connected to one of the generators and operating under the same head as the other units. Also, there are one 500-kw., 60-cycle generator, direct connected to a 60-in. wheel of 1200-hp. rating, and two 500-kw., 600-volt, d-c. generators, each driven by a direct-connected 60-in. wheel. There are two 250-kw., 120-volt exciters direct connected to the 42-in. vertical turbines; two 85-kw., 120-volt exciters belted to the horizontal turbines, and one 20-kw. exciter direct connected to the 60-in. wheel.

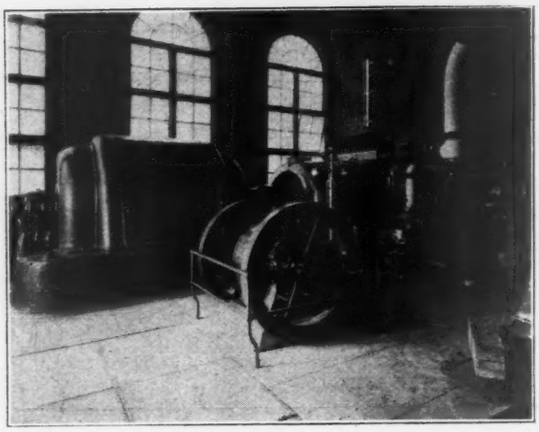
Hydroelectric Plant of the Portland Railway, Light & Power Co. at Bull Run, Ore.

In this old-style station the intention is eventually to rewind the 33-cycle generators, changing to the 60-cycle system. The d-c. output is for operating the company's street railway system. The variation in head at the waterwheels is due to back water in the Columbia river, into which the Willamette empties 20 mi. below Oregon City.

Station "G," at Casadero on the Clackamas river, was developed by means of a timber-crib, rock-filled dam, one mile above the power house. The 50-acre reservoir at the station is filled by a flume and canal, giving a 125-ft. head at the waterwheels. This plant, built in 1907, contains two 2500-kw., 33-cycle units, each driven by two 42-in. horizontal waterwheels; one 2500-kw. and one 3000-kw., 60-cycle generator, each driven by two horizontal runners, 42 and 36-in., and one 3750-kw., 60-cycle generator driven by two 39-in. horizontal turbines. This represents a capacity of 5000 kw. of 33-cycle energy and 9250 kw. of 60-cycle energy, with a total turbine capacity of 26,800 hp. There are five direct-connected exciters. At this station the 33-cycle current is stepped up from 11,000 to 33,000 volts for transmission to Portland and the 60-cycle energy from 11,000 to 57,000 volts, also transmitted to Portland.

Station "J," situated at Silverton, on Silver creek, has a 250-kw., 60-cycle unit operating under a 30-ft. head and is tied in with the Portland-Salem line.

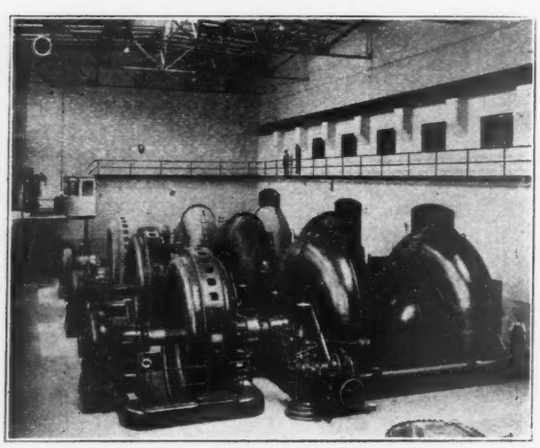
Station "M," at Estacada, known as River Mill station, is on Clackamas river. The plant contains three units of 3300-kw. capacity each, all operated at 60 cycles, 11,000 volts, 3 phase, the voltage being stepped up to 57,000 volts for line transmission. Each generator is driven by



A Part of Station "E" Steam-Electric Plant of the Portland Railway, Light & Power Co.

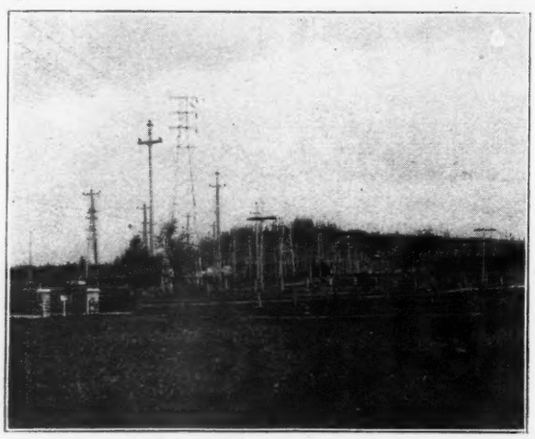
a Victor-Francis 51-in. horizontal double turbine, subjected to 81-ft. head, and of 6300 hp. rating each. There are three transformers of 3300-kw. capacity each. This energy is transmitted at 57,000 volts to Portland over a steel-tower line, containing 316 towers of an average spacing of 500 ft. The main conductor lines comprise three 19-strand No. 9 copper-clad cables with 10-ft. spacings in the horizontal plane. This development was completed during 1912.

A feature of the River Mill plant deserving special notice is the Ambursen dam and the grouting process by which the foundation material was treated. The location of the dam is at a point on the river where it leaves a deep canyon and begins its flow through an undulating country toward the Willamette. Above the dam is a watershed of 800 sq. mi., giving the river a minimum flow of 700 sec-ft. and a maximum flow of 40,000 sec-ft. The dam site is in a region of volcanic debris, or lava conglomerate, and numerous borings from 60 to 250 ft. depth showed a material of varying character, from hard rock to clay. The method adopted for installing the foundation involved the solidification of the porous material by the application of cement grout under pressure. This was accomplished by drilling a double line of holes of an average depth of 50 ft. across the valley, under the heel of the proposed dam, and forcing grout into each hole, the grout being of such consistency as would allow it to percolate through the substructure. This work required the drilling of 555 holes, amounting to 34,038 lin. ft. Both Sullivan diamond drills and the Davis-Calyx shot drills of the Ingersoll-Rand Co. were used on the work. The grouting was done with a Canniff air-stirring grouting machine, air being supplied at a pressure of 250 lbs. per sq. in.



View of Turbogenerator Room at River Mill Station of the Portland Railway, Light & Power Co.

Station "O" is the company's hydroelectric plant at Bull Run, 25 miles from Portland. A 159-acre reservoir which holds a large volume of water for this plant is filled by diverting to it a supply of water from two streams. This plan required the construction of two diversion dams, about 11 miles of canal and flume, and a 4700-ft. tunnel. The elevation of the reservoir gives a head of 320 ft. at the power house. The station equipment consists of three 3750-kw. 60-cycle generators, each driven by a 6400-hp. horizontal turbine. The substation contains a 570-kw. motor-generator set, producing d-c. energy at 600 volts for railway service, and two 150-kw. exciters driven by two 300-hp. single-runner turbines. There are six 3000-kw. transformers, stepping up the voltage to 57,200 volts for transmission to the North Portland substation.



High-Tension Steel-Tower Transmission Line of Portland Railway, Light & Power Co., from Estacada to Portland.

A summary of the foregoing shows five hydroelectric stations in the system, with a combined capacity of 42,880 kw.

Steam Generating Plants of the Portland Railway, Light & Power Co.

The company operates three steam-electric stations in Portland and one at Salem. These four are equipped for a total capacity of 22,000 kw., comprising 5000 kw. of 33-cycle energy, 14,450 kw. of 60-cycle energy, and 2550 kw. of d-c. energy.

The largest of the steam plants is station "E" in Portland, equipped as follows: Two 1000-kw., 33-cycle, 11,000-volt generators, each driven by a direct-connected vertical compound engine of 1250-hp. capacity; two 1500-kw., 11,000-volt, 33-cycle generators, each direct connected to a 3000-hp. vertical steam turbine, and one 7500-kw., 60-cycle generator, direct connected to a 10,000-hp. horizontal steam turbine. Other equipment consists of a 450-kw., 33-cycle rotary converter, producing 400 kw. of d-c.

River Mill Hydroelectric Station and Estacada Dam of the Portland Railway, Light & Power Co.

energy at 600 volts; a 375-kw., 60-cycle motor-generator set, producing 325 kw. of d-c. energy at 600 volts; and a 750-kw., 33-cycle motor-generator set, with a capacity of 800 kw. at 600 volts. Of the four exciters, one is engine driven, one is driven by an induction motor, and two are belted to the motor-generator sets.

Besides the substation equipment at each generating station, there are in the system 10 distributing stations in Portland and its immediate suburbs and 25 others in towns served by the company's light and power lines. There are 409 mi. of high-tension lines, of which 368.35 mi. are classed as transmission lines and 40.66 mi. as distributing lines. The 33-cycle and 60-cycle systems are connected through frequency changers at two points in Portland and at one point in Salem, making it possible to transmit from one to the other as demands require. Within the last year a transmission line was extended to Vancouver, Wash., crossing the Columbia river by submarine cable, and furnishing 600-volt, d-c. energy for street-car service. Direct-current energy is furnished to the company's Portland street-car system, to the Oregon electric line between Portland and Eugene, and to the electric lines of the Southern Pacific Co.

During 1919 the Portland Railway, Light & Power Co. served 2000 power consumers, whose shops, mills and factories carried a total connected load of about 77,000 kw. For the same period it had 47,000 light consumers on its lines, representing a connected load of 35,000 kw. Among its heaviest groups of power customers are the following: Woolen mills, using 1,750,000 kw-hr. in 1919; flour, feed and cereal mills, 10,000,000 kw-hr.; pulp and paper mills, 6,250,000 kw-hr.; ice and cold-storage plants, 5,000,000 kw-hr.; steel and wooden shipbuilding plants, 24,000,000 kw-hr.; lumber mills and other wood-working plants, 13,000,000 kw-hr.; cement mills, 4,000,000 kw-hr.; meat-packing industry, 3,000,000 kw-hr.; electric railways, not owned and operated by this company, purchased 27,000,000 kw-hr. of energy. There are consumers among hundreds of other industries. The power and lighting loads carried by the Portland Railway, Light & Power Co. system are now greater than at any time in its history.

Plant Equipment of the Northwestern Electric Co. of Portland.

The Portland field was entered by the Northwestern Electric Co. in 1913. Its initial development was the building of a dam and hydroelectric station on White Salmon river, in the vicinity of Underwood, Wash., and the construction of a 64-mi. high-tension transmission line from that station to Portland.

The White Salmon river heads in the glacial region of Mount Adams, in Washington, and flows southerly, discharging into the Columbia river. It drains an area of about 350 sq. mi. Most of the precipitation in that watershed is snow, and the gradual melting of snow and glaciers gives it a rather constant flow. This development is designated as the Condit plant.

The dam is situated 3 mi. upstream from the river mouth and produces a storage basin of 830 acre-ft. This structure contains 30,000 cu. yds. of concrete. It has a length of 471 ft., including a 232-ft. spillway; the base width is 88 ft. and the maximum height is 125 ft. There are five 8 by 8-ft. gates in the flow line, these being provided for operation by hand, by motors or gas engines. The flashboard was designed for flood waters of 20,000 sec-ft.

The flow of water from the headworks to the forebay is conducted through 1 mi. of wood-stave pipe, 13.5 ft. in diameter, built by Pacific Coast Pipe Co., after designs by L. M. Grant, chief engineer of that company. On this line the full load is 1230 sec-ft. at the velocity of 8.6 lineal ft. per sec. The forebay, consisting of a

Dam at Condit Hydroelectric Plant of Northwestern Electric Co. on White Salmon River.

circular concrete tank, has a diameter of 40 ft., the top of tank being 10 ft. higher than the crest of the dam. Each pressure-pipe gate is controlled at the forebay, or at power-house switchboard, the pipes themselves consisting of two wood-stave pipes, 9 ft. in diameter. The full normal load of each pipe is 615 sec-ft., of a velocity of 7.3 ft. per sec. The average normal head at the turbine gates is 160 ft.

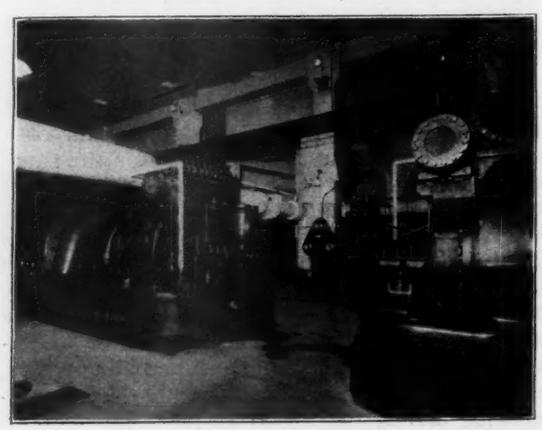
The station equipment consists of two units, each unit comprising one 6000-kv-a. generator, driven by two 4500-hp. hydraulic turbines; and two exciters, one turbine-driven and one motor-driven. Energy is generated at 2300 volts, with an outgoing voltage of 66,000 volts. The main unit is made up of an Allis-Chalmers 6000-kv-a., 2300-volt, 3-phase, 60-cycle generator of a speed of 360 r.p.m., and is driven by two Francis overhung, horizontal, double turbines of the combined maximum capacity of 9000 hp. The generator shaft is extended to carry a runner at each end; the runner receives its water through a speed gate controlled by an outside gate rigging on the quarter-turn side. Each turbine is so designed that any part may be removed without disturbing the generator. The second unit consists of a 6000-kv-a. generator of the same type as that of the first unit, but driven by two single turbines, similarly connected, in cast-iron spiral casing, with quarter-turn discharge. The turbines in both units are equipped with the Allis-Chalmers type of governors.

There are two banks of transformers, delta-star connected, of General Electric type, and one General Electric, 4-stack, aluminum-cell lightning-arrester installation.

Data on hydraulic flow shows a normal load at the plant of 1230-sec-ft.; elevation of flashboards, 290 ft.; dam flow pipe, 279.83 ft.; at entrance of surge tank, 270.59 ft. It is possible to draw down the reservoir to elevation 285 at the dam and still have ample head for 1500 sec. ft.

The high-tension line to Portland for this purpose may be sectionalized as follows: Condit

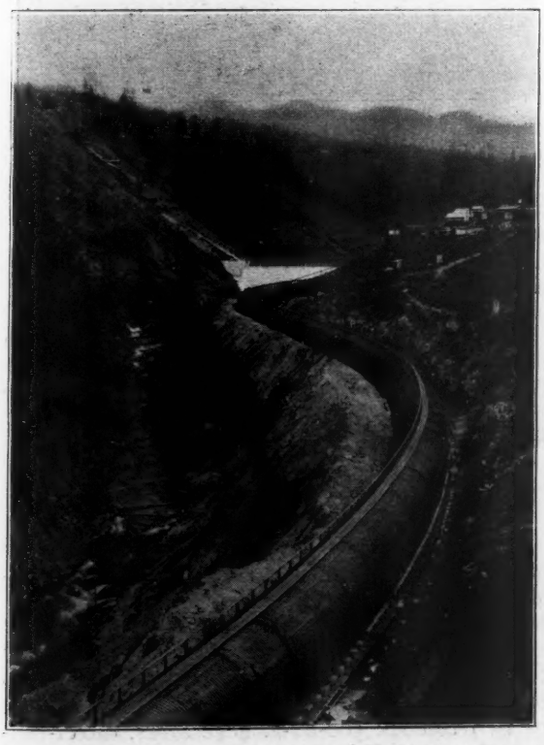
Hydroelectric Plant on White Salmon River, Showing Surge Tank and Penstocks.



Installation of Steam Turbines at Pittock Station of Northwestern Electric Co.

station to Camas, 42.2 mi.; Columbia river crossing, 1.56 mi.; thence to Albina substation in Portland, 14.75 mi. This 3-phase, star-connected, 66,000-volt line is carried on wooden poles, except over the river crossing. The poles average 45 ft. in length. The standard 300-ft. span was adopted except where surface conditions made variations necessary. Single-pole construction was adopted for spans up to 600 ft., with single arms on all straightway spans up to 450 ft. Double arms were used on angles over 5 deg. and for 450 to 600-ft. spans. Spans exceeding 600 ft. are carried on 2-pole towers of 7-ft. spacing, with double arms. In the country traversed, 75% of the holes for poles required blasting, and where guys were necessary about 50% of them were attached to drilled-rock anchors. The line across the Columbia river is carried by nine steel towers—four of the strain type and five of the supporting type. The conductor over the river is 120 ft. above high-water level. The conductor line consists of three stranded, steel-reinforced aluminum cables. The outside diameter of wire is 0.635 in., and cross-sectional area is 301,600 cir. mils. The joints are made by using McIntyre sleeves for the steel and a 2-part aluminum sleeve compressed onto the cable by hydraulic pressure of 100 tons per sq. in. Pin-type insulators were used on all single-pole construction, and strain insulators on all angles over 15 deg. and on the 2-pole tower lines. The conductors were spaced on a 7-ft. triangle. For that part of the line which extends across the Columbia river, a 0.75-in. plow-steel cable was used, and a 0.5-in. steel ground wire was strung on the tower peaks.

The substation at Camas is equipped for the distribution of power and light to a large pulp and paper mill of the Crown Willamette Co., as well as for town lighting. The Albina substation, situated on the east side of the Willamette river in Portland, is equipped with transformers for delivering energy at different voltages required for industrial loads and for lighting. The switchboard, electrically operated, with remote control, has 16 panels for controlling the incoming 66,000-volt line, and controls four 11,000-volt feeders, four 1000-volt tie lines, four 3-phase, 2400-volt feeders, and eight single-phase feeders.



Northwestern Electric Co.'s 13-Ft. Wood-Stave Pipe at Condit Plant on White Salmon River.

Generator Room in Condit Hydroelectric Plant of the Northwestern Electric Co.

Pittock Station of the Northwestern Electric Co.

The next undertaking of the Northwestern Electric Co., after the completion of its White Salmon hydroelectric development, was the installation of a steam-electric station in the subbasement of the Pittock block, situated in the heart of the city of Portland. This was completed in 1914. The four functions of the Pittock station are: (1) those of a steam heating plant; (2) a steam-electric stand-by station; (3) a synchronous condensing plant, and (4) a substation for general power and light distribution on the west side of Portland. This station floor is 27 ft. below street grade on one side and 36 ft. below on the other. The steam power equipment comprises six No. 25 Stirling water-tube boilers, with oil-burning furnaces; six superheaters and other accessories, including two multistage centrifugal feed-water pumps, driven by steam turbines. There are two General Electric non-condensing turbogenerators of 3000 kw. capacity each; two 1500-kw. synchronous motor-generator sets; two motor-driven forced-draft fans, and a panelboard.

The two main turbine-driven alternators, ex-

citers and motor-generator sets rest upon a solid slab of heavily reinforced concrete, 17 ft. thick, separated from all parts of the building structure, thus obviating vibration of the building. The two steam turbines, of the Curtis horizontal type, are each direct connected to 3500-kv-a., 1800-r.p.m., 2400-volt, 3-phase, 60-cycle alternators, rated at 80% power-factor.

The Pittock station has a 1000-volt tie line to the Albina substation, and its turbogenerators floating on the line carry most of the wattless current under manual control of the field rheostats. The distribution of light and power in the overhead a-c. system is by means of 3-phase, 2400-volt feeders. The central business district is served by an Edison 3-wire d-c. underground system. All incoming and outgoing cables to and from Pittock station are lead covered and are carried in a concrete-lined tunnel.

Steam-Electric Power Plant on the Willamette River.

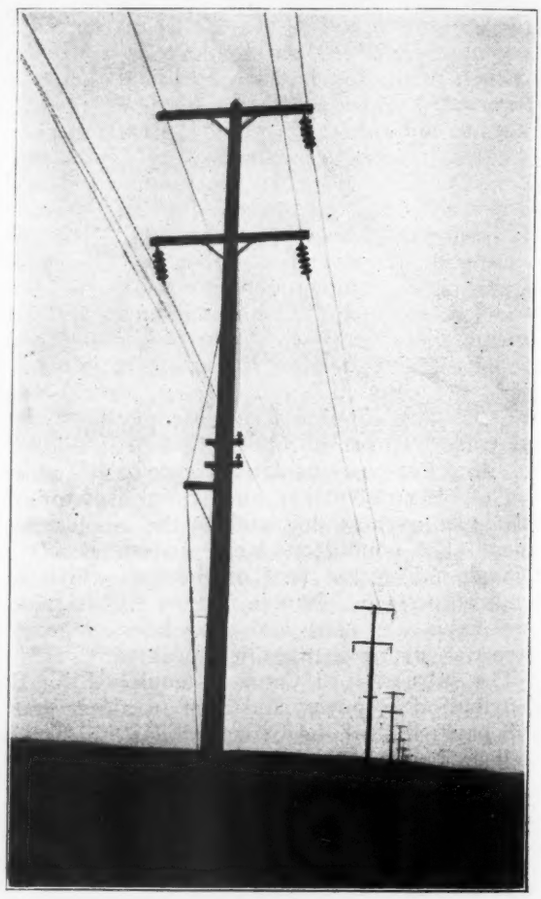
The third plant of the Northwestern Electric Co., completed in 1919, is the steam-heating and steam-electric plant on the west bank of Willamette river, in Portland. The plant is housed in a concrete structure, connected to a concrete-lined pit, 45 by 15 ft., and extending in depth 45 ft. below the level of the turbine floor. This pit is connected with deep water in the river by a concrete-lined tunnel and has a discharge line of riveted-steel pipe. Under this arrangement, condenser water is supplied by a 20-in. and a 24-in. centrifugal pump of 10,000 and 20,000 gals. capacity, each driven by a direct-connected induction motor. A Wheeler condenser with a cooling surface of 18,000 sq. ft. is set immediately below the turbogenerator set, the exhaust from the steam turbine passing directly to the condenser. The steam plant consists of six Stirling water-tube boilers, of 300-hp. rating each, but which stand a heavy overload. The boilers are equipped with double-firing oil burners at the rear end and extension furnaces in front for burning mill refuse.

The main features of the electrical equipment consist of a General Electric 7500-kw., 6900-volt, 3-phase, 60-cycle, 1800-r.p.m. turbogenerator; 4000-kw. transformers for stepping up the voltage to 11,000 volts for transmission to substations; a 100-kw. motor-generator set for producing d-c. energy and four steam turbines for operating boiler-feed pumps and other auxiliaries. The switchboard comprises generator and exciter panels, and panels for the double-circuit feeder lines, and a control panel for the storage battery and motor-generator set.

Plant Equipment of the Pacific Power & Light Co. of Portland.

The Pacific Power & Light Co., having its principal offices in Portland, serves a territory in Washington and Oregon of over 150,000 population, by means of three generating and distribution systems. These consist of the Yakima-Walla Walla system, with 16 electric generators of the combined capacity of 16,350 kv-a., and 454 mi. of transmission lines; the Dalles-Hood River system, with six generators of the capacity of 2975 kv-a., with 54.83 mi. of transmission line; the Astoria-Seaside system, with nine generators of the aggregate capacity of 5350 kv-a., and 24.34 mi. of transmission lines. The first two systems serve, primarily, agriculture and horticulture and related industries. The Astoria-Seaside system serves a diversity of manufacturing, commercial and agricultural consumers of light and power.

The generating capacities specified above are considerably increased under an arrangement for



Transmission Lines of the Pacific Power & Light Co.

reciprocal exchange with other power companies. That is, the Yakima-Walla Walla lines are tied in with the 1800-kw. hydroelectric station of the Black Rock Irrigation & Power Co. at Priest Rapids on the Columbia. They also interconnect with the Washington Water Power Co. system by means of a transmission line from Pasco, Wash., to Lind. In a similar manner the Dalles-Hood River lines tie in with those of the Northwestern Electric Co. and the Portland Railway, Light & Power Co.

Generating Stations of the Pacific Power & Light Co.

Considering first the power stations belonging to the Yakima-Walla Walla division, the following data show how its several plants are equipped.

The Walla Walla River hydroelectric plant contains four generators, driven by waterwheels operating under a 365-ft. head. These consist of two Bullock 500-kv-a. generators, direct-connected to two Pelton 1000-hp. wheels; one similar 500-kv-a. generator, driven by a Pelton 1000-

hp. wheel, and one General Electric 1250-kv-a. generator, direct-connected to a 1000-hp. Pelton waterwheel. This plant is situated 15 mi. southeast of Walla Walla.

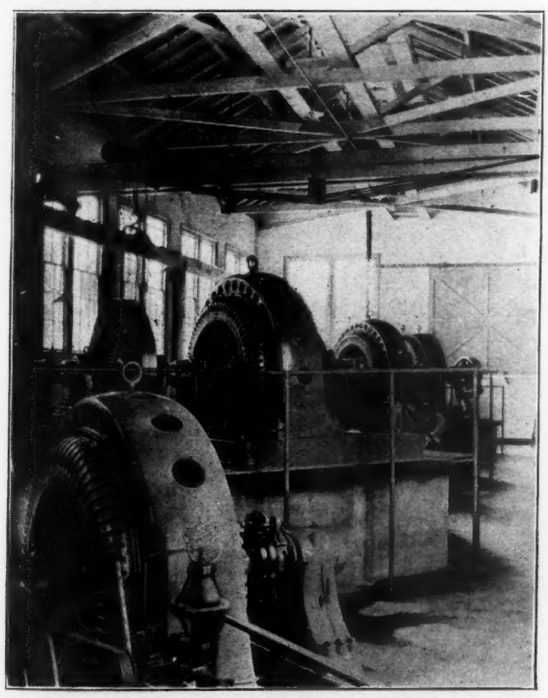
In the city of Walla Walla is a 1000-kv-a. steam turbogenerator, with two 500-hp. coal-fired boilers. The station at Kennewick consists of one General Electric 500-kv-a. generator, driven by a Curtis steam turbine.

The Tucannon plant, near Pomeroy, Wash., contains one 150-kv-a. generator, driven by a 250-hp. waterwheel, operating under an 82-ft. head.

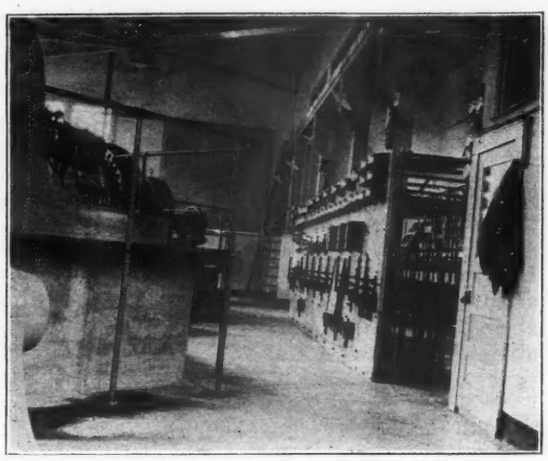
The two hydroelectric units at Prosser consist of a 400-kv-a. and a 200-kv-a. generator, direct-connected to 338 and 330-hp. waterwheels operating under a head of 17 ft.

The Naches station, on Naches river, 9 mi. from Yakima, contains four General Electric generators, three operated by water turbines and one by a steam turbine. The water turbines are subject to 151-ft. head. The three hydroelectric units are made up as follows: One 3000-kw. generator direct connected to a 3600-hp. Francis turbine; a 3750-kv-a. generator driven by a 5000-hp. Pelton Francis waterwheel; a 750-kw. generator, operated by a 1500-hp. Pelton wheel. The steam unit consists of a 2000-kw. generator, driven by a Curtis 2000-hp. steam turbine.

The Naches Drop plant contains electric stations of Tygh Valley, Powerdale, Tucker's Bridge, Goldendale and Husum. The largest of these is the Tygh Valley plant, situated on White river, 25 mi. south of The Dallas, Ore. It is equipped with one 1250-kv-a. generator, driven by a 1900-hp. Pelton waterwheel and two 500-kw. generators, driven by two 900-hp. Pelton Francis waterwheels. The waterwheels work under the pressure of a 143-ft. head. Powerdale station contains a 350-kv-a. hydroelectric unit;



Interior View Showing Generators in the Walla Walla River Hydroelectric Plant of the Pacific Power & Light Co.



Interior View Showing Switchboard in the Walla Walla River Hydroelectric Plant of the Pacific Power & Light Co.

that of Tucker's Bridge a 300-kv-a. unit; the plant on the Klickitat, near Goldendale, Wash., a 150-kv-a. unit, and the Husum plant a 75-kv-a. unit.

Astoria-Seaside System of the Pacific Power & Light Co.

The stations embraced in this system are all steam-driven. The Astoria power plant is equipped with a 500-kw. and a 750-kw. General Electric generator, and two motor-generator sets, of 250-kw. and 300-kw. capacity, for producing direct current. The plant of the Hammond Lumber Co., in the vicinity of Astoria, from which Pacific Power & Light Co. purchases power, has three steam-driven generators of 2600-kw. capacity. The latter company has a 390-kw. steam plant at Seaside.

The most important feature of the Astoria system is the new 3000-kw. turbogenerator unit which Pacific Power & Light Co. has under construction on Young's Bay. This includes a boiler plant of three 600-hp. Stirling boilers, to be served by a concrete stack 220 ft. high. Energy at the new plant will be produced at 11,000 volts and transmitted at 22,000 volts to the Astoria substation, and there tied in with the existing system.

The transmission lines of the Yakima-Walla Walla division comprise 340.6 mi., transmitting energy at 66,000 volts, 54 mi. at 25,000 volts, and 11 mi. at 2300 volts. The longest lines consist of a 93.77-mi. line between Pasco and Yakima, and a 66.11-mi. line from Pasco to Lind, the latter being the location of the substation through which a connection is made with lines of Washington Water Power Co. Most of the 66,000-volt lines of the company are carried on pin-type insulators. However, there are nearly 160 mi. at that voltage carried on suspension insulators, comprising the lines from Yakima to Priest Rapids, from Pasco to Lind, and between Walla Walla and Tucannon; also the 26.5-mi. line from Tygh Valley to The Dalles.

There are, on the three systems described, 73 transformer stations, nearly all 3-phase, and connected either open or closed delta. The transformers are both of the oil-insulated, self-cooled and of the oil-insulated, water-cooled types. That number of installations include those at

power stations and those of inclosed and outdoor substations in the entire territory served by the company.

Power Plants and System of the Washington Water Power Co.

The territory served with power and light by the Washington Water Power Co. comprises the greater part of what is known as the "Inland Empire." Its four hydroelectric plants are situated on the Spokane river, the largest of these, and the one of most recent construction, being at the lower end of Long Lake, which is an expansion of that stream. Its transmission lines not only connect the plants with Spokane but extend north, south, east and west into the vast territory served. They comprise lines running easterly into the Coeur d'Alene mining district, northerly to Newport and Northport, southerly to Colfax, Pullman and Moscow, and westerly into the Big Bend wheat region. By means of a high-tension line built from Long Lake to Taunton, an interconnection is made with the Puget Sound Power & Light Co. system for the operation of trains on the Chicago, Milwaukee & St. Paul railway. Over a similar line from Lind to Pasco there is an interconnection with the distribution system of the Pacific Power & Light Co.

Hydroelectric Installation at Long Lake on Spokane River.

The Long Lake hydroelectric station was built at the horseshoe bend of the Spokane river where the stream flows through a box canyon. A masonry spillway dam, 353 ft. long, 208 ft. high and 250 ft. thick at the base, was built across the canyon on the upstream curve of the horseshoe bend.

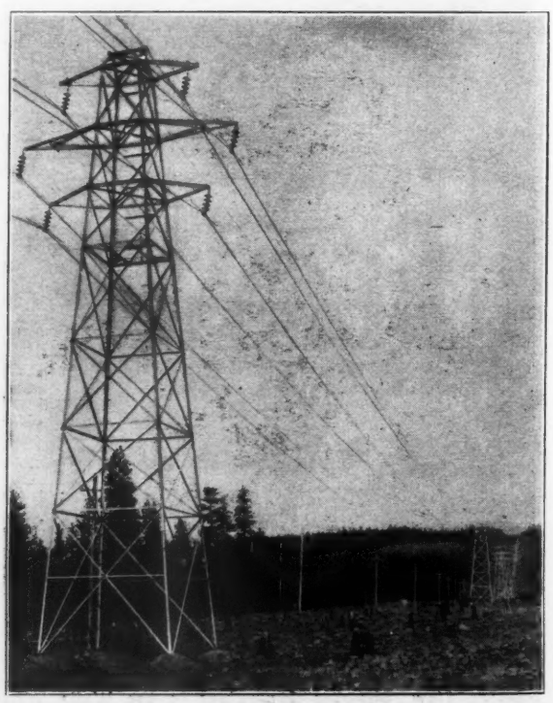
The power station is situated at a point 250 ft. downstream from the dam, on the lower curve of the river. The headgate section of the dam, which is joined to the left-bank end of the spillway dam and extending at right-angles to it, is 240 ft. long, 100 ft. high, 100 ft. thick at base and 18 ft. at the top. A third dam—an arched, cutoff structure—was built across a gulch to hold back the overflow at a place on the river 900 ft. above the spillway dam. The cutoff dam is 260 ft. long, 100 ft. high, 50 ft. thick at base, and its upstream face was built on a 170-ft. radius. All foundations for the dam were built on solid rock and during construction required a great deal of rock excavating.

The four steel-plate penstocks, extending through the masonry of the headgate dam to the turbines, are each 263 ft. long and have an upper-end diameter of 16 ft. and a lower-end diameter of 14 ft. 10 ins. The plant contains five hydroelectric units, each consisting of a 22,500-hp. I. P. Morris hydraulic turbine, direct-connected to a 13,900-kv-a. General Electric generator. The generators are supplied with air from tunnels opening directly into the generator pits. Each generating unit is connected by cable to a bank of three single-phase, 6500-kv-a. transformers, delta-star connected. The equipment is housed in a T-shaped brick building, with concrete foundation. The turbines operate at 200 r.p.m., under a 168-ft. head.

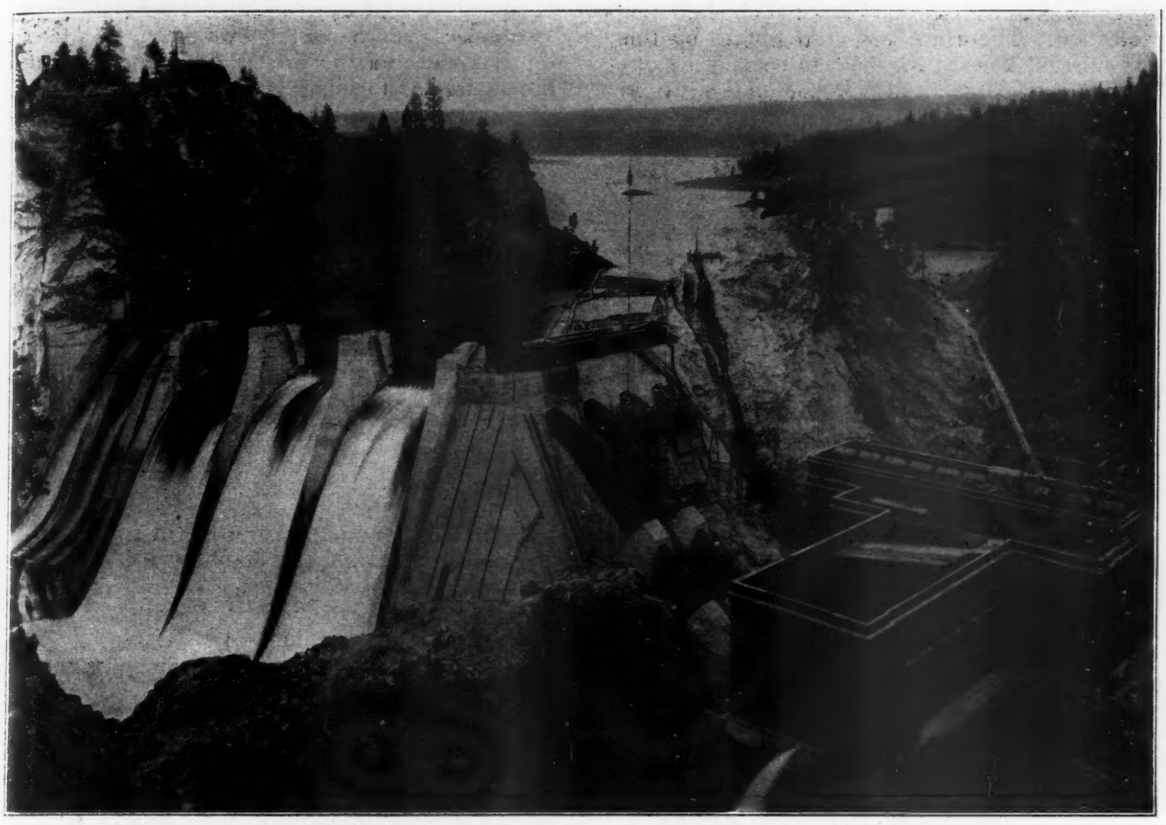
Little Falls Hydroelectric Plant.

The Little Falls plant, situated on Spokane river, 6 mi. downstream from the Long Lake plant, was built in 1910. Water power was developed at this site by the construction of a masonry dam, creating a back-water reservoir that extends 4.5 mi. upstream. The dam is 1760 ft. long, the spillway section having a length of 650 ft. and a height of 64 ft. The power plant comprises four 5500-kv-a. generating units, built for operation at 3-phase, 60 cycles and 400 volts.

Little Falls Hydroelectric Plant of Washington Power Co., on Spokane River, Near Spokane, Wash.



Tower on Double-Circuit 60,000-Volt Transmission Line From Little Falls Plant to Spokane.



Hydroelectric Station of Washington Power Co. at Long Lake, Spokane River, From Which 100,000-Volt Energy Is Transmitted to the Power Line of the C., M. & St. P. Railway's Pacific Coast Division.

Each generator is driven by a Morris 9000-hp. horizontal, twin waterwheel. Each wheel has a capacity of 11,250 hp. when operating under 173-ft. head at 150 r.p.m.

Post Falls Hydroelectric Plant.

The Post Falls plant is a five-unit station, 20 miles east of Spokane, and was completed ten years ago. Each of the five 2250-kw., 2300-volt generators is direct connected to and driven by a Francis horizontal, central-discharge, double-runner waterwheel, operating under a 50-ft. head of water. This voltage is stepped up to 60,000 volts for line transmission by a 2200-kv-a., 3-phase transformer. A short distance above this power site the Spokane river forms in three channels which unite at a point below the power site. The Post Falls plant was built on the middle channel, and by constructing dams and controlling gates on the two outside channels the head of water on the middle channel is raised 10 ft. above normal low water.

Spokane Hydroelectric Plant.

The original hydroelectric station of this system, situated within the city limits of Spokane, has been in service more than 20 years. It has a producing capacity of 8800 kw. and is equipped with two 2250-kw. generators, driven by Platt Iron Works turbines. The other units consist of waterwheels direct-connected to generators of sizes ranging from 1200 kw. down to 200 kw.

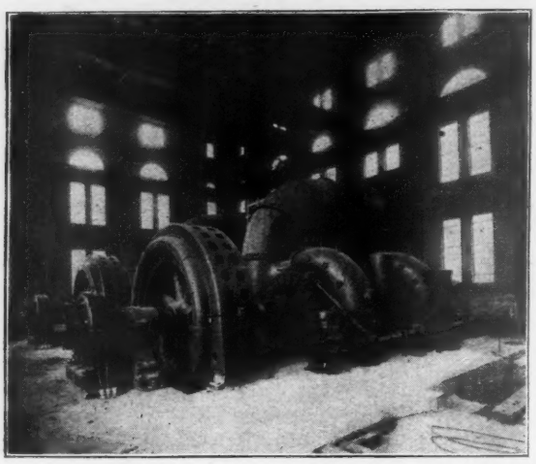
An auxiliary steam-electric station in the city of Spokane is equipped with 12 Babcock & Wilcox 500-hp. boilers and two Curtis steam turbines, one of which drives a General Electric 9000-kw. generator and the other a 5000-kw. generator of similar type. This plant is held in reserve to answer emergency demands.

Transmission Lines.

The company's distribution system contains over 600 miles of 60,000-volt lines, the greater part being 3-wire lines carried on cedar poles. The outgoing lines from Post Falls station consist of four of 60,000-volt and one of 2300-volt capacity. One of the high-tension lines transmits energy to the Coeur d'Alene mining district, where there is a heavy power load; another extends 40 miles north to Newport; two other 60,000-volt lines run to a substation in Spokane, and the 2300-volt line supplies energy for an interurban railway system.

The 60,000-volt lines going out from the Little Falls station consist of a 3-wire line to Davenport and other towns to the west, and a similar line to the Long Lake station; also, a double-circuit steel-tower line, 28 miles long, to a Spokane substation. Those steel towers are 16 ft. square at the base, 4.5 ft. square at the top and 50 ft. high. They are built of 4 by 4 by 5/16-in. galvanized angle iron, bolted together, and braced by angle bars. Some of the angle-iron posts are anchored in a concrete base. Each tower carries three 4-in. steel crossarms. The conductors on each side are 7 ft. apart vertically and consist of 19-strand aluminum cable of 270,000 cir. mil. cross-section, and are suspended from the crossarms by four 10-in. insulator units, the length of the insulator and cable clamps being 34.25 ins. The towers also carry two 3/8-in. Siemens-Martin galvanized steel cables on the

tower peaks, with ground wires, for lightning protection. There are 225 steel towers on this transmission line, of an average spacing of 625 ft. The Long Lake hydroelectric station ties in



Interior View of Washington Power Co.'s Plant at Long Lake, on Spokane River, Near Spokane, Wash.

with existing lines previously described. The company's distribution of power is made from more than 30 substations.

Plants of the Puget Sound Power & Light Co. of Seattle.

The Puget Sound Power & Light Co., of Seattle, formerly the Puget Sound Traction, Light & Power Co., serves light and power in six counties of western Washington, comprising those of King, Pierce, Thurston, Snohomish, Skagit and Whatcom. The company operates four hydroelectric power stations of a combined capacity of 123,915 hp., and four steam-electric plants of a combined capacity of 42,680 hp., making the total available power 166,595 hp. The plant representing its greatest hydroelectric development is the White River station, at Dieringer, in which there are three units of a combined capacity of 61,733 hp. The two stations on Snoqualmie river consist of six units of a total capacity of 26,333 hp.; the plant at Electron, on Puyallup river, develops 26,666 hp., and that on the Nooksak river, in Whatcom county, produces 2680 hp. In addition to the power produced at the company's own hydroelectric plants, energy amounting to 6700 hp. is derived from the Stave Lake hydroelectric plant of the Western Canada Power Co.

The hydroelectric stations on Snoqualmie, White and Puyallup rivers are all interconnected by high-tension transmission lines, forming a system by which power and light are served in the counties of King, Pierce, Snohomish and Thurston. This system, dependent principally on electrical energy produced by water power, is reinforced by four auxiliary steam-electric plants as follows: Georgetown station, 30,660 hp., and Post Street station, 4200 hp., both in Seattle; Tacoma station, 3000 hp., and Everett, 3000 hp. There is also a steam-electric plant of 2680 hp. at Bellingham, which is auxiliary to hydroelectric service in Whatcom county.

The White river hydroelectric station is equipped as follows: Two General Electric 15,000-kw., 6600-volt, 360-r.p.m. generators direct connected to two Allis-Chalmers 18,000-hp. hydraulic turbines, operating under a head of 440 ft.; one General Electric 16,300-kw., 6600-volt, 360-r.p.m. generator driven by direct connection to an Allis-Chalmers 23,000-hp. turbine. Lake Tapps storage basin, from which this station draws its water supply, stores a maximum of 56,000 acre-ft.

Snoqualmie Falls station No. 1 contains five generating units, equipped as follows: Four Westinghouse 1500-kw., 2000-volt, 3-phase, 300-r.p.m. generators, each direct connected to an Abner Doble Co. ellipsoidal, tangential waterwheel, and one Westinghouse 5000-kw., 2000-volt, 3-phase, 300-r.p.m. generator direct-connected to a Platt Iron Works 9000-hp. Victor turbine. Snoqualmie Falls station No. 2 is equipped with one General Electric 8750-kw., 6900-volt, 360-r.p.m. generator direct connected to an I. P. Morris 12,000-hp. turbine. The hydraulic turbine and waterwheels at plant No. 1 are subject to a 270-ft. head, and the turbine at plant No 2 operates under a 286-ft. head. The pondage above those two plants amounts to 450 acre-ft.

Electron hydroelectric station, on Puyallup river, is equipped with four General Electric 5000-kw., 2300-volt, 225-r.p.m. generators, each driven by a Pelton hydraulic turbine. The head of water utilized at this plant is 865 ft. and above which is a pondage of 450 acre-ft.

All the hydroelectric generators are 3-phase, 60-cycle machines.

The principal steam-electric station is known

Snoqualmie Falls, Where There Are Two Generating Stations of the Puget Sound Power & Light Co.

as the Georgetown plant in Seattle. It contains 16 Stirling boilers of 500-hp. capacity each, and three generating units, described as follows: All three generators are General Electric type, each one being driven by a Curtis direct-connected, steam turbine. The first-unit generator is rated

Generating Station at the White River Hydroelectric Development of the Puget Sound Power & Light Co.

at 5000 kv-a., 13,800 volts, 3-phase, 720 r.p.m.; that of the second unit is rated at 8000 kv-a. and in other respects is the same as No. 1; and the generator in the third unit is a 10,000-kv-a. machine, having a speed of 1800 r.p.m. and otherwise similar to the other two.

The Post street steam-electric station, in Seattle, is equipped with eight Cahill boilers of 500 hp. capacity each, two Westinghouse 1600-kv-a., 2200-volt, 2-phase, 120-r.p.m. generators driven by vertical compound, McIntosh-Seymour engines, rated at 3880 hp. Energy produced here is for lighting circuits. Other equipment at this station consists of five 550-kw. rotary converters, producing d-c. energy for street-railway service; five 500-kv-a. rotary converters, producing d-c. energy for lighting, and storage batteries for emergency use.

The Union street substation, Seattle, is provided with five motor-generator sets for producing d-c. energy. These consists of three General Electric 1000-kw., 275-volt, d-c. generators, each direct connected to and driven by a synchronous motor, and two Westinghouse 1500-kw., 275-volt, d-c. generators, each driven by a direct-connected synchronous motor.

There are in Seattle nine substations in which motor-generator sets and converters are operated to supply the heavy d-c. demands for street railways and interurban lines, as well as for lighting. Included is a new substation on Spokane and Colorado streets, in which was installed a 1000-kw. rotary converter and a 500-kw. motor-generator set, to supply energy for railway service.

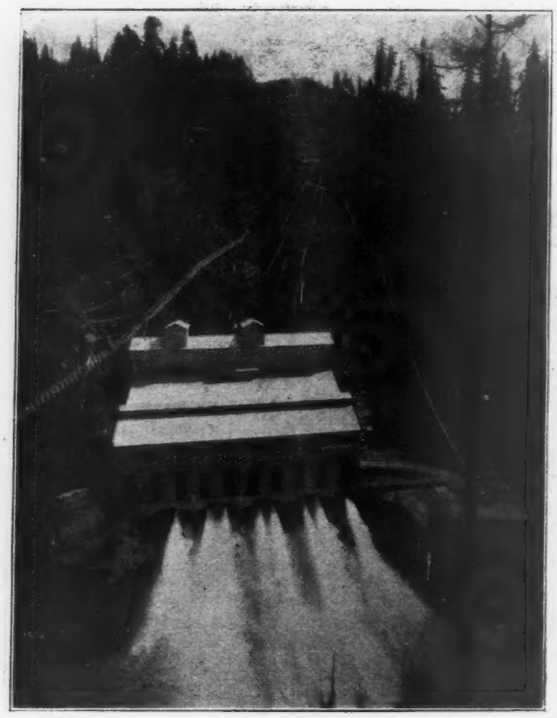
Transmission Lines.

The high-tension lines transmit at 55,000 volts, with conductors, in most cases, of either copper or aluminum, and these include both double and single-pole lines. Running out from the Snoqualmie river plants there are two single-pole, 55,000-volt lines of four bare copper wires extending 40 mi. to Everett. The two run parallel about half that distance, down Snoqualmie river, and one line runs northerly to Everett via Monroe and Snohomish; the other strikes westerly from Duval, passing through Bothell to the Everett interurban right-of-way, thence directly north to Everett. Two other similar lines go out from the Snoqualmie stations, paralleling each other for 21 mi. to Renton substation, each consisting of No. 00 aluminum wires. From this substation are lines feeding into the White river station, and another feeder line to Seattle.

From White river generating station there are two double steel-tower lines, 2 mi. long, to Bluffs. Two separate 55,000-volt transmission cables are carried on each set of towers. At Bluffs they connect with previously built transmission lines running between Seattle and Tacoma. These tower lines carry No. 0000 copper conductors. Another high-tension line runs from White river station to Tacoma, Camp Lewis and Olympia, a distance of about 45 mi.

The Electron generating station is interconnected with the White river station by two 55,000-volt lines of No. 0000 copper conductors, having a length of 18 mi., and a third line of the same voltage runs from Electron to White river plant by way of Carbonado, Wilkerson and Buckley, about 40 mi. in length. Those three places are coal-mining centers in which there are substations for serving power and lighting to the mines and towns. Another line extends from Buckley northerly to Enumclaw, Cumberland and Kanaskat, which are coal-mining towns. There is, also, a 2-mi. tie-line from Renton Junction, by which the Snoqualmie Falls power lines are tied in with those extending from Bluffs to Seattle.

The transmission lines in the Bellingham divi-



Puget Sound Power & Light Co. Hydroelectric Station, "Electron," on Puyallup River.

sion comprises a 30-mi. line from Sumas to Bellingham, a 35-mi. line from the Nooksak river hydroelectric station to the city last named, and the towns on the Skagit river, including Burlington, Sedro-Woolley and Concrete, are served by a power line running out from Bellingham, which is about 60 mi. in length.

The power load on this company's lines is made up of service that extends to a wide range of industries and utilities. Energy required to operate passenger and freight trains on the Pacific Coast division of the Chicago, Milwaukee & St. Paul Railway is divided between the Puget Sound Power & Light Co. and the Washington Water Power Co. That required for the operation of street-car and interurban traction lines amounts to a considerable item. The commercial load in Seattle and other Puget Sound cities, for motor drive in shops, shipyards, mills, factories and on dredges is constantly increasing. Outside of the cities the power demands at coal mines, cement mills and sand and gravel plants are factors of importance.

Power Plants and System of the Montana Power Co.

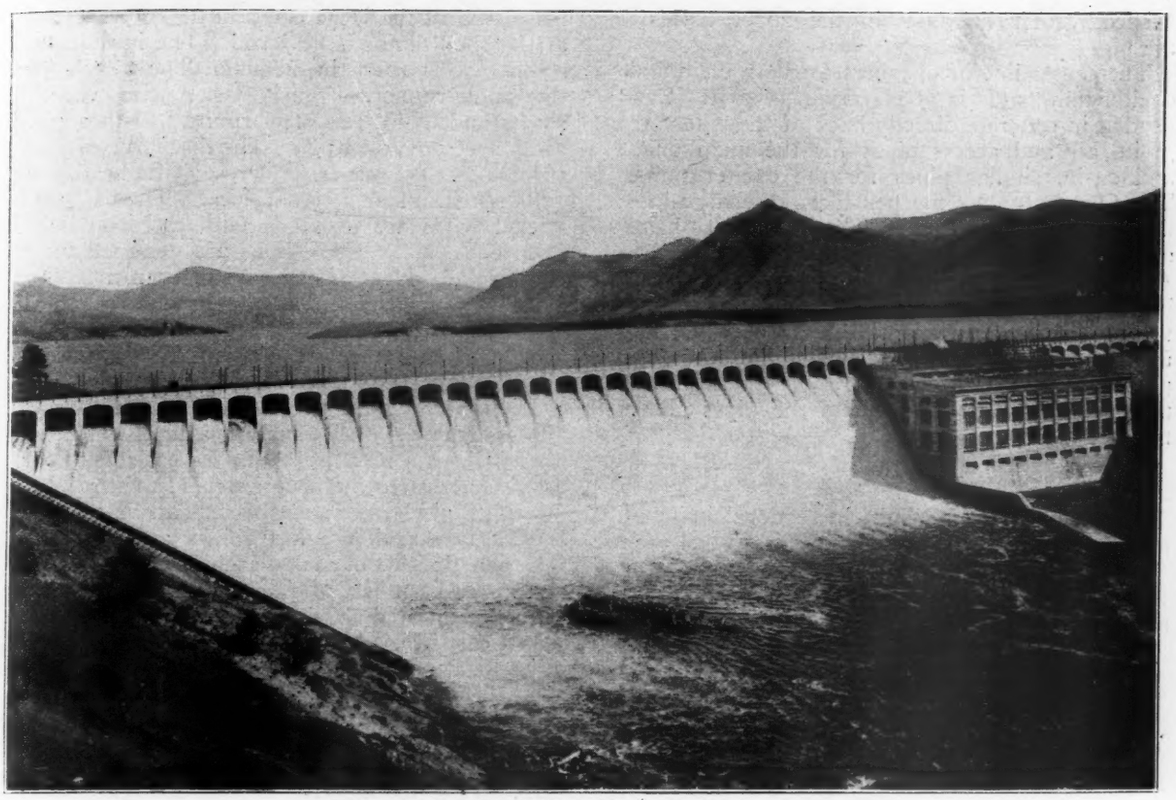
This Montana Power Co. has a total of 12 hydroelectric plants, seven of which are on the Missouri river, two on the Madison river, one on the Big Hole river, and one on the Yellowstone river, the latter streams being tributaries of the Missouri river. The station at Thompson Falls, among the newer plants of the system, is on Clark's Fork, a branch of the Columbia river system. It will be seen, then, that in the production of power there is a utilization of streams on both sides of the continental divide.

The distribution lines transmit power to all classes of industries, for public utilities and for domestic uses to a constantly increasing extent. Among all these there is a steadily maintained consumption of energy, accompanied by some heavy increases in demands. The mining and metallurgical industries of this section stand first as power consumers, and the electrified railroads second. In connection with metal mining, the requirements for electrical energy are likely to increase rather than diminish, as the future outlook does not indicate a lighter demand for the metals produced. As regards the railroads, the facts available show such efficiency and economy in operation by electric power that the further electrification of lines, especially in a region of great hydroelectric possibilities, would seem to be inevitable. This tendency is accentuated by the great necessity for fuel conservation on a national scale. Then, within the territory served, the consumption of energy for domestic appliances is very high, as based on population. The fact that electrical energy is everywhere available and takes the place of domestic help, which is not available, has led to the constant increase of this desirable type of load.

The Holter Development.

The site of the Holter hydroelectric plant is on the Missouri river, about 40 mi. north of Helena and 4 mi. from Wolf Creek station on the Great Northern railway. The concrete dam, which is of gravity type, has a length of 1364 ft. This includes the ogee spillway, intake and abutment sections. The southwest abutment is 400 ft. long and the northeast abutment is 91 ft. long. The spillway section, with 14-ft. flashboards, has a net spillway length of 558 ft. and is designed for a flood flow of 90,000 cu. ft. per sec. over the crest, with headwater at elevation 3562 ft. The base width of the spillway, not including the apron, is 180 ft. The apron construction is 76 ft. long, having two rows of diamond-shaped

One of the Penstocks Entering the White River Station of the Puget Sound Power & Light Co.



Holter Hydroelectric Power Plant of Montana Power Co.

baffle piers, 17 ft. between rows, with piers spaced 16 ft. on centers. The top of the apron is flush with the river bed and the height of the dam from that level to the crest is 104 ft.

The intake section, of concrete, gravity type, located between the spillway and the southwest abutment, forms an integral part of the dam proper and also forms the back wall of the power house. The entire dam structure supports a 14-ft. roadway. That part over the spillway is supported by 4-ft. concrete piers, spaced 22 ft. on centers. The 10 bays at the northeast end of the spillway have 14 by 18-ft. drop gates of timber, equipped with two screw stems working in sleeve nuts driven through bevel gears. The gate hoists are operated by a 50-hp. motor, the power being transmitted from a line shaft through friction clutches. The 21 other bays of spillway have semi-permanent flashboards, 14 ft. high and 18 ft. wide, that can be released by knocking out pins.

Waste Gates.

There are six sluices, 5 ft. in diameter, spaced 16 ft. 8 ins. on centers, at the southwest end of the spillway and adjacent to the intake section. Each sluice has a wooden emergency gate, 8 ft. wide by 7 ft. high, placed on the upstream face of the dam. For normal operation there is a 60-in. inside-screw gate-valve located 25 ft. from the upstream face of the dam, and in a tunnel, 8 ft. wide by 11,5 ft. high, inside the dam. The tunnel is connected with the top of the intake section by a shaft 8 ft. long and 4.5 ft. wide. At the discharge end of each sluice is a cast-iron nozzle, 15 ft. 3 ins. long, with a 5-ft. diameter inlet and an outlet 10 ft. wide by 2 ft. high on the down-stream face of the dam. The center line of sluices is at elevation 3478 ft. The discharge capacity of one sluice with the pond at elevation 3562 ft. is 1160 cu. ft. per sec., the total discharge of the six sluices being 6960 cu. ft. per sec.

The wooden gates for the four main-unit penstocks have double-screw stems and those for the exciter units have single-screw stems. The screw stems work in sleeve nuts, driven through bevel gearing. The hoists for this equipment are operated by a 50-hp. motor through friction clutches on a line shaft. Stop-log grooves are provided at gate openings through the intakes.

Penstocks.

Each main unit opens through the intake leads into a riveted-steel penstock, 14 ft. in diameter by 124 ft. long, with a tapered section, 19 ft. 8 ins. long, connecting with the scroll case of the turbine. The inlet of the scroll case is 2 ft. 6 ins. in diameter. The main-unit penstocks are made of 47 ft. 11 ins. of ½-in. steel plate, 30 ft. 4 ins. of ⅝-in. and 45 ft. 9 ins. of 11/16-in. plate. The two exciter-unit penstocks are each 132 ft. 3 ins. in length, 5 ft. in diameter, and are made up of 71 ft. 5 ins. of 5/16-in. plate and 60 ft. 10 ins. of ⅜-in. plate. The maximum velocity in the main-unit penstocks is 10.3 ft. per sec., with wheels developing 16,450 hp. under 109-ft. head, and a water consumption of 1585 cu. ft. per sec. Exciter-penstock velocity is 3.6 ft. per sec., with wheels developing 730 hp. under 109-ft. head, and a water consumption of 71 cu. ft. per sec. The main-unit penstock rings are 7 ft. 7 ins. in length and are made of three plates, with adjacent rings staggered so that longitudinal joints come 2 ft. apart. Exciter-penstock rings are about 7 ft. 3 ins. long and are made of one plate with longitudinal seams of adjacent rings staggered 45 deg. each side of the

vertical center line and in the upper half of the pipe.

The center line of openings for both main and exciter-unit gates is at elevation 3537 ft. Embedded in concrete directly back of the gates are 36-in. air and access pipes for the main units and 24-in. similar pipes for the exciter units. The filler gates for the penstocks discharge into these air and access pipes. These gates are hand operated with a screw-stem bevel-geared hoist. All air and access pipes are covered at the top by a grating and have a 14-in. pipe, 2 ft. below the top of intake section, with its outlet at the upstream face. These air and access pipes are provided with 6-in. auxiliary vents, from the penstocks, which connect with the pipes above the filler-gate entrance.

Racks.

Overhanging racks, built in sections, in front of the intake section, are supported by steel rack frames resting upon 36-in. built-up cantilever beams embedded in the concrete of the intake structure and are also fastened to the pier noses at the front. The main racks are inclined at a slope of 1 to 12. Horizontal sections are at the bottom of the rack structure and rest upon beams between the supporting cantilevers for the rack structure. All rack bars are 4 by 5/16 ins. on 3-in. centers. The rack section is 166 ft. long with a maximum water depth of 40 ft. and a minimum water depth of 26 ft. The gross maximum pond area is 8160 sq. ft. and the net maximum is 7310 sq. ft. The gross minimum pond area is 5700 sq. ft. and the net minimum is 5100 sq. ft.

The exciter-penstock screens, placed in stop-log grooves in front of the penstock gates, are made of galvanized wire screening, of ½-in. mesh No. 8 B. & S. gauge wire, stretched on three steel frames to each penstock. The gross area of each frame is 94.5 sq. ft.

A 10-in. supply line for camp irrigating is carried through the southwest concrete abutment. This supply is controlled by a 10-in. gate valve on the upstream face of the abutment and is protected by a screen.

The fishway, constructed at the northeast abutment, runs parallel to the splash wall, water being admitted through eight 18-in. steel pipes running through the abutment wall. These pipes are spaced on 7-ft. 4-in. centers, with center lines set at eight different elevations. Wooden gates are placed at the upstream end of the steel pipes for controlling the water to the fishway. The fishway is 6 ft. high by 8 ft. wide, with baffles spaced 2 ft. on centers.

Power House.

The power house is constructed of steel frame with walls, floors and roof of concrete and has a length of 208 ft. along the intake structure, a width of 81 ft. and a height of 64 ft. above the first floor. The floor space afforded is 26,880 sq. ft., not including basement. The power-plant building rests upon a solid concrete foundation that extends to bedrock.

The four main-unit water wheels are of S. Morgan Smith Co. design, each rated at 13,500 hp., 150 r.p.m., when operating under a gross head of 95 ft. The scroll cases are of 5/8-in. plate steel at the large end and of 7/16-in. plate at the small end of the scroll. The inlet to the scroll case is 12 ft. in diameter. The wheels are the single-runner, Francis type, with vertical shafts and 95-in. cast-steel runners, with a runaway speed of 255 r.p.m. The discharge of each turbine is 1475 sec-ft. under a 95-ft. head, and 1585 sec-ft. under a 109-ft. head. The cast-steel wicket gates are provided with cast-iron links, bronze bushed. These links are designed to be the weakest parts of the gate mechanism. One link will break when a gate becomes clogged, thus allowing the other gate to close. The weight of the turbine shaft, runner, downward-thrust runner and generator rotor is carried on a Kingsbury thrust bearing placed at the top of the generator. Each unit has a platform inside the pit liner, 4 ft. 3 ins. above the basement floor, to give access to the generator and to steady the bearings, air brakes and governor drive.

The two exciter-unit turbines are of the S. Morgan Smith Co. make, each rated at 600 hp., 450 r.p.m., under 95-ft. gross head, and are direct connected to the generators. Each unit has a cast-iron scroll case with a 30-in. inlet and a 30-in. runner with a wicket gate. This is the Swain type of single-runner turbine, with vertical shaft, having a runaway speed of 855 r.p.m.

The draft tubes for the main turbine units are of cast iron and concrete, have a throat diameter of 9 ft. 7 ins. and outlet dimensions of 17 by 29 ft., with circular ends of 8½-ft. radius. Along the center line there is a cast-iron section 6 ft. 7½ ins. long and a concrete section 22 ft. 7½ ins. long, giving a total draft tube length of 29 ft. 3 ins. The velocity at the throat is 20.5 ft. per sec. under a 95-ft. head with a volume of 1475 cu. ft. per sec. The velocity of the outlet is 3.42 ft. per sec. under the same head and volume. Under 109-ft. head and a volume of 1585 cu. ft. per sec., the velocities at the throat and outlet, respectively, are 22 and 3.68 ft. per sec.

The governors embody the central, open, oil-pressure system, with double-supply mains and single-drain mains. The system operates at about 200 lbs. per sq. in. pressure, the oil being supplied to the governors by two motor-driven, rotary oil pumps equipped with unloading valves. The oil pumps have a capacity of 150 g.p.m. Each pump is connected by a silent-chain transmission to a 25-hp. motor. An air and oil pressure tank, set near each unit, is connected to the governor air-main in the basement. Air is supplied at 200 lbs. pressure by a 6 by 3 by 7-in. tandem, compound, motor-driven compressor. Between the air mains and compressor is an air-storage tank, 3 ft. 9 ins. in diameter by 9 ft. high. The main unit actuators are the S. Morgan Smith type of oil-pressure relay-valve design. The governors have remote-control, load-limiting devices, tachometer, gate-opening indicators and auxiliary hand pumps for governing by hand control. Safety devices are also provided to shut down the unit in case the governor drive should break.

In the Holter plant there are four Westinghouse, 3-phase, 60-cycle, 6600-volt, vertical generators rated at 12,000 kv-a. and operating at 150 r.p.m.

Each generator has one Kingsbury oil-lubri-

Four 12,000-Kv-a. Units in the Holter Plant of the Montana Power Co.

cated thrust bearing situated above the rotating field. Below the thrust bearing is an oil-lubricated guide bearing 3 ft. in length. A similar bearing of the same length is located below the rotating field. The ventilating fans and blowers are placed at both top and bottom of rotor, the top of the generator being completely closed. The terminals are on the lower side and the field slip rings are between the rotor and upper steady-bearing.

The exciter sets consist of two d-c. generators with vertical shafts, arranged for direct connection to water wheels. Each generator is rated at 500 kw. and 250 volts. Each exciter is large enough for the excitation of all four main generating units.

The plant contains four 12,000-kv-a., oil-insulated, water-cooled, 3-phase transformers. The high-voltage windings are Y-connected and designed for 107,000 volts. The low-voltage windings are delta-connected for 6600 volts. The transformers are mounted on structural steel trucks and are provided with lifting slings for removing the coils and iron from the tanks.

The switchboards comprise four 20-in. generator panels, two bus-sectionalizing panels and five line and transformer panels. Auxiliary switchboards are also provided for local power, storage battery and lighting control.

The general leads consist of two 700,000 cir. mil cables per phase. These are all for 6600 volts, and have 8/32 in. of varnished cambric insulation covered with a double braid of cotton saturated with weatherproof compound. The exciter leads, consisting of two 1,000,000 cir. mil cables, are insulated with 7/64-in. of varnished cambric. All main leads are carried in fiber conduit with waterproof joints. All instrument and control wiring is installed in iron conduit. The busbars are located in concrete structures.

Equipment of Some of the Smaller Plants in the Pacific Northwest.

The Wenatchee Valley Gas & Electric Co., of Wenatchee, Wash., operates a 2-unit 1500-kw. hydroelectric plant on Wenatchee river at Dryden and a similar plant of 1025 kw. on Entiat river. The Dryden plant is equipped with S. Morgan Smith water turbines and Westinghouse generators, operating under a head of 55 ft., the water being delivered through 6100 ft. of canal and two penstocks 100 ft. long. The Entiat plant has two units operating under a 78-ft. head, the water being carried to the turbines by 6800 ft. of canal and a penstock 1750 ft. long.

This system is supplemented by the Chelan Falls Power Co., which has a hydroelectric plant on Chelan river at the point where it empties into the Columbia river. At this plant 800 kw. is developed by an Allis-Chalmers generating unit, the turbine operating under a 35-ft. head. By means of a 20-mile transmission line from Chelan Falls plant to Entiat the plant is tied in with the Wenatchee system. The three plants, at Dryden, Entiat and Chelan Falls have a combined capacity of 3325 kw., which seems to be about fully consumed in light and power service. During the spring and summer seasons the company has a pumping load of 1200 to 1500 hp. in connection with irrigation.

The Northwestern Power & Manufacturing

Co., which has a hydroelectric station of two 3000-kw. generating units on Elwha river, in the vicinity of Port Angeles, Wash., some time ago placed the property under the management of the Washington Coast Utilities, Inc. It has 110 miles of 66,000-volt transmission lines, from which Port Angeles, Port Gamble and other towns are served. Where one line crosses Hood's canal, a 9000-ft. submarine cable was laid, whereby the company's carrying capacity was doubled. Transformers of 3000-kv-a. capacity are installed on each side of the canal and the voltage is stepped down to 15,000 volts for submarine transmission.

The Okanogan Valley Power Co. of Spokane has developed hydroelectric power on the Similkameen river, near Oroville, Wash. A dam was constructed, giving a head of 80 ft., and one generating unit of 2000 hp. was installed. This company also produces electric power at Bridgeport, Mansfield, Riverside, Okanogan, Brewster, Pateros and Omax, Wash.

The North Coast Power Co., having its principal offices at Portland, Ore., is typical of the smaller power companies of the Northwest. It serves light and power to a number of towns in the state of Washington, including Woodland, Kalama, Kelso, Castle Rock, Vader, Winlock, Napavine, Chehalis, Centralia, Bucoda and Fenino; Ranie on the Oregon side is also served. It has a steam-electric plant at Chehalis and a hydroelectric plant at Kalama, the two having a capacity of 2200 kw. The company has 72 miles of 45,000-volt transmission lines, some of which extend to pumping plants in diking districts, where about 510 hp. is required during the spring and summer.

POTENTIAL WATER POWER IN THE PACIFIC STATES.

Washington and Other Northwestern States Have Vast Amount of Potential Water Power Awaiting Full Development.

One of the most remarkable natural assets of the state of Washington is its abundance of potential water power. The heavy precipitation which is characteristic of that state, and the steep slopes of the mountains causing it, result in a number of rivers of steep gradient and considerable flow which are possible of utilization for power generation.

One remarkable and fortunate feature of Washington streams is that they often supplement each other. Thus one stream may be fed mainly from glacier and snow fields, and another may be fed from an area which does not store the moisture to a large extent either in the ground, as ground storage, or in the form of snow or ice. The latter stream will have a good flow during the wet season and the former will have a small flow because the precipitation will be in the form of snow. In the dry, hot season, conditions will be reversed; the glaciers and snow fields will melt and furnish a good flow to the former stream, while the flow of the latter will be much reduced on account of the slight precipitation. The power of either stream alone would be subject to greater variations than would the sum of the powers of both. If power developments were made on both streams by connecting them together, the two could furnish more continuous power than if each were operated independently. Much of it, indeed, would be too costly in development to render it of commercial importance under the present conditions of market and the price of fuel power.

The accompanying tabulation shows an estimate, made by the Commissioner of Corporations, of the ultimate amount of power available for development in the western states and also in the entire United States. The tabulation shows figures of minimum and assumed maximum values based on 75% efficiency of conversion from potential energy of water to actual usable electrical power.

ELECTRICAL POWER AVAILABLE FROM POSSIBLE HYDROELECTRIC DEVELOPMENT IN THE NORTHWEST.

	Minimum hp.	Assumed maximum h.p.
Washington	4,932,000	8,647,000
Oregon	3,148,000	6,613,000
California	3,424,000	7,818,000
Idaho	1,162,000	2,567,000
Montana	2,749,000	4,331,000
Western states, including all those having drainage into the Pacific Ocean	18,996,000	36,707,000
United States	26,736,000	51,398,000

The tabulation shows, therefore, what will be the maximum possibilities in the day when our fuel shall have become so exhausted that the price thereof for production of power is prohibitive, and the people of the country shall be driven to the use of all the water power that can be reasonably produced by the streams.

The report defines the estimates of maximum and minimum power as follows: "The estimates for the minimum power are not on the minimum flow for any day, or even on the lowest average for a very few consecutive days during the entire period covered, but are based on the averages of the minimum flow for the two lowest periods of seven consecutive days in each year for seven years, or less, according to the length of the period for which records were available. The assumed maximum development rests on quite a different basis. It is based upon the continuous power indicated by the flow of a stream for the six months in the year (not necessarily six consecutive months) showing the highest flow. From the flow during the lowest seven consecutive days in the months of high flow for each year, averaged for a period of seven years, or less, if the records covered less, the assumed maximum power was calculated."

It is evident that the "minimum" power, as here determined, is really the maximum continuous or all-year power which will be available in the future. It does not mean that it is the least, but is, on the contrary, the most that can be expected in the future, for, as observed before, the availability of much of the power will be possible only after many years have elapsed. However, it should also be borne in mind that these figures do not take into account the equalization of flow by means of storage and that by use of storage a considerable amount of power in the "maximum" class would be transferred to the class of continuous or "minimum" power by means of increasing the minimum flow.

Factors in the Market for Utility Securities

Failure of Financial Institutions to Furnish Sufficient Capital for Needed Extensions and Improvements Is Causing Change in Market for Public Utility Company Securities

The changing market for the securities of public utility companies is causing concern to managements these days and is a subject of frequent and earnest conferences between the parties involved. There can be no question but what the market for utility securities is changing, and it is becoming more and more apparent that the small investor will be a much larger factor in utility financial circles than in the past.

Two main reasons can be assigned for this condition. One is that most banks and financial institutions are not evidencing a great desire at the present time to have much to do with financing the needs of the utilities throughout the country. The other reason is that utility companies, in many cases, have come to the conclusion that investment in their securities by the small investor in the community served by them not only serves to bring in some of the money needed but also works out as an asset of goodwill to the company.

Just how large a figure the small investor will amount to as a means of furnishing necessary financial aid to the utilities is another matter of deep concern to the executives of the companies. At the best, it is pointed out, the small investor cannot be depended upon to furnish more than a very small proportion of the great amount of capital now needed by utility companies in all parts of the country. It leaves the utilities still dependent on financial institutions for the bulk of monetary assistance needed, and, according to reports from most sections of the country, considerable difficulty is being experienced.

Utility Companies Are Hemmed in by Regulations.

The reason for this does not need to be long sought. Banks and other financial institutions do not look with favor on loans to utilities or to handling of their stocks, for the reason that the earning power of utilities is curtailed by all sorts of restrictions. City ordinances in connection with franchise rights frequently place a limit on the amount that can be charged for service by a utility company. Beyond this there is the regulation of rates by the state utility commissions, and, in the case of the larger companies operating in more than one state, by the Interstate Commerce Commission.

Public utility companies, as a result, are limited as to earning capacity, this in most cases ranging on about a 8% basis, and if a company is found to be earning more than that figure a demand for a reduction in rates is generally made to the utility commission governing the particular company and in many instances such lower rate is ordered into effect.

With this limited earning capacity utility companies are forced, when dealing with financial institutions for loans, to bid against industrial concerns that are not hampered by any limit placed on their earning powers by commission regulation. It is not difficult to understand that it is easier for an industrial company making, say, 25% a year on its investment, to sell its stock or float loans with the aid of banking institutions than it is for a utility company limited to a low rate of income on its investment.

The situation in the Middle West right now seems especially serious and many bankers in that section have openly declared they do not care to make loans or have anything to do with the financing of stock sales by utility corporations. And all classes of utilities suffer alike. Central-station companies, telephone companies, gas companies and traction lines are all having difficulty in getting any financial assistance from the banks.

Money for Utilities Easier to Obtain in Eastern Section.

In other sections of the country the situation does not seem so acute. Advices from California show that millions of dollars is being furnished through banks on the Pacific Coast for electrical development, particularly in connection with hydroelectric projects. This may possibly be explained as due to the fact that the financial institutions of the Pacific Coast realize that the development of the water power now going to waste means development of the entire section and not the development of the electrical industry alone.

In the East, money for the extension and improvement of utilities is not as hard to get as it is in the Middle West and many big projects are under way in that section. In Connecticut, Pennsylvania, New York and New Jersey projects have been financed since the first of the present year in which millions are involved, the utility companies having been either able to market stock through banks and investment houses or else arrange a loan at rates of interest that are not considered excessive.

Despite all the difficulties in connection with obtaining financial aid that have existed throughout the past three years it is noteworthy that the stocks of utility companies throughout the country have remained on a practically even level in the stock market. Instances of decided decline in prices are few, and can generally be traced to purely local causes. On the other hand, many public utility stocks have advanced substantially during the past three years and even during the past year, when the stringency in the money

market has been particularly acute as concerns utilities.

That utility stocks have not dropped in price argues well for the underlying financial soundness of most utility companies and therefore makes them a good and safe investment at all times. Utility bonds, being a more flexible type of collateral, have shown a wider range of prices throughout the past three years, but at the present time bonds of most companies are very close to the same figures they brought three years ago.

For the very reasons given above the stocks and bonds of utility companies should appeal to investors, both large and small. An additional reason is that probably in no other line of industry is the management of such a conservative nature as that of the utility company, this being especially true with reference to the central-station companies serving the larger communities of the country.

How Some Companies Have Made Sales of Stock.

But to companies large or small the changing character of security buyers offers a substantial field of endeavor in obtaining investment by the small stockholder in the community in which the company operates. One large central-station organization operating in several widely scattered states has been making a systematic effort to interest the people of the communities which it serves in the preferred stock of the company, with the result that in the five-year period it has sold stock to over 16,000 persons and has derived investment of over $11,000,000 from this source. In some localities this company has been able to finance all construction work during the five-year period out of the proceeds of stock sales to its customers and small investors in its territory.

Another company, which operates in the vicinity of Chicago, has within the past two months sold 20,000 shares of its preferred stock in the territory covered by it, the sales in this case being made through a campaign by employes of the company working under the direction of company executives.

The two cases above demonstrate that public utility stock can be sold to the public if the proper effort is made and indicate that financial needs, to a limited extent, can in the future be obtained from this source.

Despite the relief afforded by the small investor, the real basic difficulty at the present time is that a limited amount of financial aid is of but little avail to most utility companies. They need an extraordinary amount of aid, due to the fact that during the war period every utility company in the country was pressed to the utmost to keep up with the demands made on it by the government, and had no time or opportunity to make improvements or extensions needed for expansion after the close of the war period. Even had the companies had the time and opportunity they would have been unable to get the necessary materials.

Hence the after-the-war period found utility companies in the position of needing immediately large amounts of money in lump sums for necessary improvements and extensions, which under ordinary conditions would have covered expenditures running over a period of from three to four years. In other words, it might be said that the companies need three or four times as much money as they would have needed had conditions not been abnormal for the past three years, and even for a longer period.

Managers of some companies are of the opinion that after the present period of stress is passed the money needed for betterments and extensions can be obtained through the sale of stock to small investors, and for that reason are strongly urging the education of such investors to the naturally intrinsic value of the stock in a company operating in the territory in which the investor resides.

Bankers point out that the country is still passing through the after war adjustment period, that any talk of such an occurrence as a panic is unjustified, and that under the present federal reserve system a panic is practically impossible. It is admitted there is a credit stringency and that it is necessary that manufacturers and industries curb expenditures as much as possible.

Another reason given by the bankers for the tightness in the credit situation is the method used by the government in financing war expenditures and which resulted in a great burden being forced on the bands. Interest rates on Liberty loans were not made high enough and the result was that the bond issues were not properly distributed, and those that were distributed among the general public carried such a low rate of interest that they have been thrown on the market for sale or else put in banks as security for loans.

Banks Are Carrying Heavy Burden for Government.

Approximately half of the loans of the federal reserve banks have been made on government securities. This means the banks are carrying the burden, which was intended to be assumed by the people as a whole. It means that the banks have only about half the funds they otherwise would have for loans for commercial purposes.

It is this set of circumstances that makes it difficult for public utility companies to obtain financial aid from banks and fiduciary institutions for, as pointed out earlier, the utilities are forced to bid in the open market for money against other industries that are not hampered by regulatory control as to rates charged for service.

Just where relief is to come from is something that is worrying many a banker and utility executive today. Bankers realize that unless utilities are aided and kept up to the proper measure of efficiency the whole community in which the utility operates suffers. But, in many instances, loans are refused and the utility faces a depreciation of its plant and a loss in revenue due to not being able to make improvements and extensions.

There is one bright aspect in the situation, and that is that many utilities, through force of circumstances, have succeeded in selling stock to small investors in their own territories and have thereby built up good-will and a community interest that will undoubtedly prove of lasting benefit.

Electric Furnace Power Problems of the Central Station

Operation of Electric Furnaces as Considered from the Standpoint of Central-Station Companies and Furnace Operators — Electric Furnace Practice—Paper Before American Electrochemical Society

By WALLACE G. BERLIN

Electric Furnace Operator, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

There has been a marked increase in the number of electric furnace installations during the past year. This increase is due not only to the high grade of steel produced by the electric furnace and now demanded by the steel market but also to the fact that, under the many conditions of operation met at the present time, the electric furnace can compete commercially in the production of small castings with converters as well as with the crucible process. Electric furnaces, when properly operated, produce a grade of steel which will readily replace crucible steel, thus eliminating the older and more expensive process.

Progressive power companies are now studying electric furnace demands in a broader and more thorough manner than heretofore. In the course of this study they find it more desirable to meet the general operating conditions of furnaces rather than the special conditions of individual installations. They find it desirable to encourage the use of electric furnaces in order to improve their average load-factor and, therefore, their earnings.

Cheap, Reliable Power a Factor in Electric Furnace Operation.

One of the principal factors in the economical production of steel in the electric furnace is low consumption of reliable and cheap power. Actual cost of power is not to be considered at the expense of continuous service and absolutely reliable continuous supply of power is the first requisite of cheap power.

The following cases illustrate this point: A furnace was operating under an average load of 800 kw. A breakdown in the power house resulted in the stopping of one generator supplying the furnace, which made it necessary to reduce the furnace load to 500 kw. This condition continued for an hour, during which time the melting advanced slowly, if at all, thus increasing the time of the heat and the power consumption. Another furnace was connected to the lines of a central station having no reserve equipment. The power failed when the charge in the furnace was melted, but not hot enough to pour into molds. The operator held the heat until it finally froze in the furnace. On receiving power the following day, the solid mass had to be remelted, an operation requiring double the time and energy necessary to melt the original charge. During this remelting the hearth was cut to such an extent that patches had to be burned in before operations could be resumed. Interruptions of this character were so frequent that the furnace had to be abandoned. The losses sustained under these conditions are measured not only in the cost of the additional power consumed, the labor wasted or the damage to the furnace, but, what is more important, in the decrease of furnace output.

With a reliable power supply the factors which control low power consumption consist of high load-factor or continuous operation, which results in a large tonnage output; strong, energetic furnace men, with good common sense, who can act in emergencies; and proper selection of scrap, which should be small and clean. Large scrap requires more time to melt down, and clean scrap helps to eliminate oxidation.

In selecting an electric furnace it is equally important to consider the daily output as well as the rated capacity of the furnace. Furnaces of the same rated capacity have unequal daily tonnages, depending upon the number of heats possible. This variation in the number of heats depends upon the process used. A furnace operated on the basic process may be capable of producing 6 heats in 24 hours of continuous operation, while the same furnace operated on the acid process may produce 10 heats in 24 hours of continuous operation.

Basic-Process Furnace Practice.

The furnace practice in the basic process consists of patching the banks with dolomite as soon as a heat is poured out, introducing the next charge, which consists of heavy melting scrap, then lowering the electrodes and turning the power on at the full capacity of the transformers. In about 30 minutes a pool of molten metal is formed under each electrode, during which period the power input fluctuates heavily. Lime is then added and the power input settles down to a steady value, excepting for small fluctuations due to scrap falling on the electrodes. In about 1.75 hours the charge is melted, a sample is withdrawn and the carbon percentage determined by analysis or fracture. The bath is then "ored down" or "pigged up" until the proper composition is reached. The slag is then drawn off and a new slag made of lime and fluorspar. After coking over with ground coke the desulphurizing and deoxidizing start, and in 20 minutes a white slag is formed which completely deoxidizes the steel in 30 minutes. Alloy additions are then made and the heat is brought up to the pouring temperature.

In melting manganese-steel scrap the same practice is followed, except that only one slag is

used. More trouble is encountered in starting the heat, due to the poor contact caused by the coating of rust prevailing on all manganese scrap. A higher voltage is advantageous to overcome the rust coating and, in every case, it is necessary to start a heat by making contact with iron rods and working the material until the arc continues without assistance. This difficulty increases the time of a heat from 2.5 to 3.5 hours. During the melting-down period the power fluctuations are heavy and of momentary duration, causing unbalanced-phase conditions.

A furnace load with these characteristics should necessarily be connected to a central station capable of producing large blocks of energy, otherwise the heavy surges, caused by the poor contact and intermittent arcs, would produce poor voltage regulation. The central-station company and the furnace operator have to consider from different standpoints in deciding whether the investment in an electric furnace or the investment in the power plant and transmission lines should or should not be made. From the operator's standpoint the decision depends on the market for his product, the amount of power that will be required and the existence of a power supply of a reliable nature. The central-station company has to consider all its investments as permanent or distributed over a long period and should charge back, against a furnace load, the expense contingent on the service. Hence, the smaller central-station companies, as a rule, cannot and the less progressive will not equip themselves to handle the new furnace loads without charging excessive rates, for they have to take into account the impossibility of selling their capacity to some other industry in case the furnace is abandoned. Since the electric furnace can compete in production with other processes, there is no reason to anticipate an installation shutting down as long as the required reliable supply of power is furnished to the furnace.

Another vital point in connection with the power supply is the fixing of rates by public service commissions and regulations affecting distribution. The limitations imposed by such regulations are illustrated in the case of a power company of limited capacity which undertook to supply a medium-sized furnace. The result was that very irregular service was given, limiting the furnace output to a small percentage of its possible capacity. The load-factor was small with resulting large power consumption and excessive charge per kw-hr. Within a few miles of this plant a central-station company was operating with a sufficient capacity and reserve to provide the furnace with a steady supply of power. If the operators had been able to buy power from this larger plant they would have had steady service, increased output and decreased power consumption, so that their costs per ton of metal would have been greatly reduced, and the furnace installation would have been successful instead of a burden to the operator.

Influence of Rates for Energy on Electric Furnace Operation.

Rate schedules are based on two main items. The first item is a demand or ready-to-serve charge, which covers overhead charges, interest and depreciation on the power plant, substation and transmission lines supplying the customer's load. This is a just charge, as long as the load is connected to the lines whether any power is used or not, as this capacity cannot be used to supply other loads. The second item is the energy charge, which covers the running expenses, fuel, attendance, etc. This charge varies according to the hours that the load is used, as recorded by integrating wattmeters.

Rate schedules are presented in printed form and often seem complicated to the consumer. It is not necessary for the furnace operator to be confused, for, if he will state his operating conditions, the power engineer will determine the proper rate and explain it quickly. The essential factor to the furnace operator is the cost of power per ton of steel produced and not the detail of how the cost is figured.

The central-station company can usually supply the large consumer at lower rates than those quoted to the retail trade because the cost of service and the investment for equipment necessary to supply the large consumer is less per unit than that necessary to supply the smaller consumers. The character of the power supply is also considered in rate making. Since the regulation of the power for electric furnace is not necessarily as close as that required for ordinary industrial power and lighting loads, the furnaces may merit some special reductions.

There is no occasion for serious consideration of power-factor at the present time, as a well designed furnace, if properly installed, will operate at a power-factor of 80 to 90% during the early stages of the melting period and at a power-factor of 95% during the refining stage. High current surges can be taken care of by the use of artificial reactance.

Wholesale Power Rate for Operation of Electric Furnaces.

The following wholesale power rate may be taken as a fair example of the average make-up of rates submitted to power consumers with a connected load of 200 kw. or larger:

(1) Demand charge per month:
For the first 200 kw., $1.50 per kw.
For the next 800 kw., $1 per kw.
For excess over 1000 kw., $0.75 per kw.
(2) Energy charge per month:
1.5 cents per kw-hr. for the first 10,000 kw-hrs.
1.0 cent per kw-hr. for the next 90,000 kw-hrs.
0.8 cent per kw-hr. for the next 200,000 kw-hrs.
0.6 cent per kw-hr. for excess over 300,000 kw-hrs.

Maximum demand is determined, at the option of the company, from the customer's connected load (total of nameplate ratings) or by suitable instruments (same to be calculated by averaging the daily recorded maximum 30-minute peaks of the month). The succeeding 11 months' billing are based on these calculations, unless the connected load is increased.

Minimum charge for any month, whether energy is used or not, shall be no less than the demand charge.

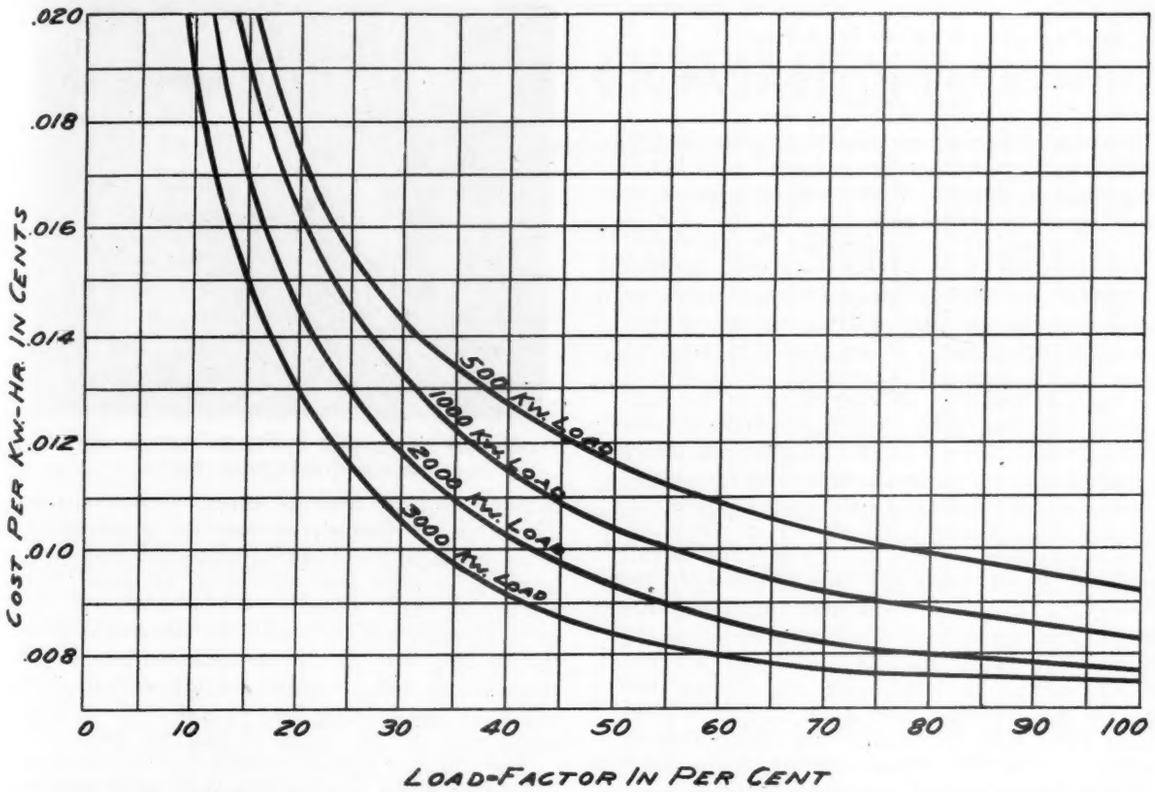
Deduction of 5% on the demand charge will be made if the customer takes and measures current at central-station company's primary voltage.

Successive deduction of 5% on the total bill will be made for payment within 10 days from date of bill.

No discounts for use of off-peak power will be considered.

No deductions for maintenance of good power-factor will be considered.

The curves in the accompanying illustration show the average rates that would apply under



Curves Showing Rates per Kw-Hr. Resulting from Operating Furnaces at Various Demands and Load-Factors.

various conditions of furnace operation on the above rate schedule. For example, a 3-ton furnace operating on a demand of 1000 kw. and a load-factor of 20% (which would be the operating conditions running single-shift and turning out 3 heats per day) would earn a rate of 1.6 cents per kw-hr. The same furnace operating on a 24-hour schedule, or with a load-factor of 45%, would earn a rate of 1.1 cents per kw-hr. With a power consumption per ton of steel of 700 kw-hrs., the saving in power alone would amount to $3.50 per ton of metal. Under the same conditions, a furnace with a demand of 3000 kw. and operating on a load-factor of 20% would earn a rate of 1.35 cents per kw-hr., and operating on a 45% load-factor would earn a rate of 0.9 cent per kw-hr. This shows that the larger furnace using the larger block of energy, even with the higher demand, will earn a rate, which, if considered alone, would favor the larger installations; also that the small furnace operated a greater number of hours will earn a rate better than a large furnace operated only a few hours per day. A 3-ton furnace operating at a 1000-kw. demand and having a 45% load-factor would earn a rate of 1.1 cents per kw-hr., while a larger furnace with a demand of 2000 kw. and a 20% load-factor would only earn a rate of 1.47 cents per kw-hr. The advantage, of course, is with the smaller furnace operated at full capacity, rather than with the large furnace operated at half capacity.

Parallel Operation of Electric Furnaces.

Parallel operation of two or more electric furnaces, taking power from a single station, is economical when there is an ample and reliable power supply, provided they are run to capacity. If two furnaces are operated on the same line it is not probable that the demand will be doubled, since the fluctuations may not occur simultaneously. In furnace practice the heavy fluctuations occur in the melting-down period, and, if the furnaces are operated to avoid these fluctuations occurring at the same time, the charge in the first furnace should be completely melted before the next furnace is started up. With a 3-ton furnace running on a schedule of one heat every 3 hours, of which 2 hours are spent in melting and 1 hour in refining and charging, the capacity of the furnace is 8 heats or 24 tons per day. The second furnace would be started 2 hours later than the first, and its charge would only be half melted when the first furnace would be ready to start again. Thus a delay of 1 hour would be necessary so that a heat would be poured from each furnace every 4 hours instead of every 3 hours, thereby reducing the capacity per furnace to 6 heats or 18 tons per day. The result on the power demand would be a reduction of about 500 kw., with a loss in production of 6 tons of metal per furnace or a total loss of 12 tons per day. The effect of this restricted operation would be to lower the load-factor from 45 to 35% and to reduce the demand from 2000 to 1500 kw. The curves show that such a change would increase the rate from 1 to 1.2 cents or by 0.2 cent per kw-hr. With a power consumption of 700 kw-hrs. per ton of steel, this increase in rate due to restricted operation would amount to $1.40 per ton of metal produced, without consideration of the loss of 12 tons output of metal per day.

A further advantage of unrestricted operation is that, if large heats are needed for heavy work, two furnaces can be poured at the same time without the necessity of a large capacity furnace. In cases where small work only is done, a large

furnace may be unsuitable because of the time and molding space required for a heat.

Advantages of Off-Peak Power in Furnace Operation.

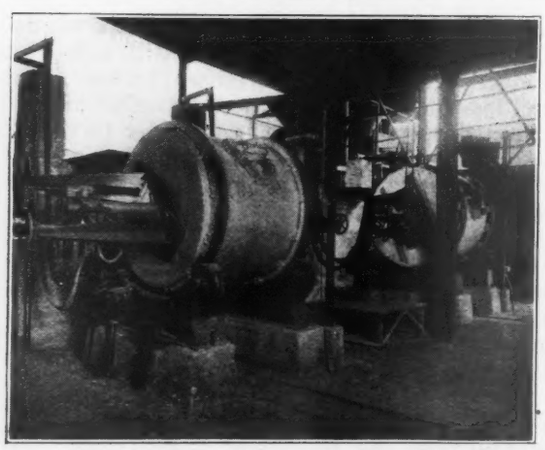
There are hours or periods of the day during which it is highly desirable to keep heavy loads off the power circuits. The usual periods are at the start of the industrial day and for 2 or 3 hours after sunset, depending on the character of the industrial load. Most companies supplying power are willing to quote lower rates to furnace operators who will agree not to use power at such times. When power is supplied from a small station it is sometimes advisable to arrange the schedule of operations to use off-peak service and take advantage of these concessions, since, in any event, the power is likely to be cut off at times of heavy load and the schedule might well anticipate such a condition.

From the operator's standpoint it would be more economical to run the furnace on a full schedule, thus keeping the load-factor high, reducing the losses of heat and increasing the efficiency of operation. It is important that the furnace should be operated with the shortest possible period between heats, for during such periods the operator loses a portion of his demand time, thus increasing the ready-to-serve charge. Also the furnace lining cools down quite rapidly and the electrodes oxidize away more rapidly than when melting a charge. In some cases the off-peak rates are available at prices which do not include more than a portion, if any, of the demand charge. In such cases it is more economical to operate the furnace during off-peak periods such as at nights and on holidays.

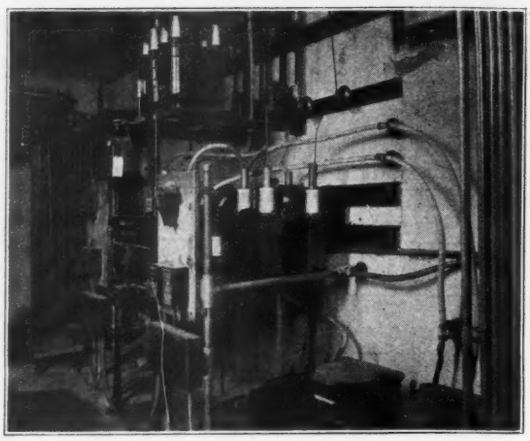
FIRST ELECTRIC BRASS FURNACES ON PACIFIC COAST.

Installation of Two Furnaces Made at Plant of Oregon Brass Works, Portland, Ore., for Melting of Brass.

The first installation of electric furnaces on the Pacific Coast for brass melting was made recently in the foundry of the Oregon Brass Works, Portland, Ore. The installation consists of two Detroit indirect-arc, rocking furnaces, one of which has the capacity to handle a ½-ton charge per heat, and the other a 1-ton charge. This type of furnace consists of a cylindrical drum made of ½-in. boiler plate, the end plates being so riveted and welded as to make them withstand extra pressure. The eccentric ring gears at each end, by which the furnace is given the rocking motion, are so mounted as to give the melting metal a slight lateral motion. The effect of the rocking and lateral motions is to vigorously stir the metal during the heat.



Two Electric Furnaces for Melting Brass in Oregon Foundry.



Transformer and Control Equipment for Operating Furnaces in Oregon Brass Works.

The furnace lining consists of one layer of insulating brick next to the shell wall, then an intermediate denser lining of corundite brick, and the inner lining, which comes in contact with the molten metal, consists of a still denser layer of corundite. In this type of furnace 4-in. graphite electrodes are used.

The ½-ton furnace is operated by a 2.2-hp. induction motor, the rocking motion being accomplished by reversing the motor, controlled by contactors mounted on the control panel, which in turn are controlled by means of an automatic switch, actuated by the driving motor.

The arc of the circle through which the furnace rotates is sufficient to cause the melted metal to wash four-fifths of the lining area.

The smaller unit of the two draws 1250 amperes at 121 volts, requiring 150 kw. at the electrodes, the time required per heat being about 1 hr. The 1-ton furnace requires 300 kw. The automatic rocking controller is shown in the accompanying illustrations, as is also the hand control for pouring operations. During the time of charging the electrodes are withdrawn, so as not to interfere with feeding heavy scrap.

One of the great advantages of this type of furnace, as set forth in a compilation of operating data, is that it effects a saving of about 75% of the metal waste by oxidation and volatilization that results in operating a combustion furnace. Interesting data on melting costs and many other facts in connection with operating a ½-ton furnace of this type were published in Electrical Review of Feb. 7, 1920.

Oregon Brass Works, Inc., has been in business many years and meets a big demand for marine and structural bronze, castings and similar products, and W. F. Prier, president of the concern, has taken the lead, on the Pacific Coast, in equipping his foundry with electric furnaces. Electric power is furnished by the Portland Railway, Light & Power Co.

EDITORIAL COMMENT

The N. E. L. A. Convention

Following the notable "win the war" convention of 1918 and the "peace" convention of 1919, the National Electric Light Association will hold its 1920 annual session in Pasadena, Cal., next week.

The meeting, as yet not named by any special title, might aptly be called the "constructive" convention, for vital questions touching upon the readjustment and on the future work and scope of the electrical industry, particularly that of the central-station companies, will be discussed during the five days the association is in session.

In addition, there will be considered plans which, if adopted, will virtually "reconstruct" the organization of the association itself. Proposed changes in the constitution will permit the organization of the United States into geographic divisions, with the Dominion of Canada as a separate division. The geographic division plan will undoubtedly work to the benefit of the electrical industry as a whole. That it will be a material aid to the member companies is evidenced by statements made by numerous central-station men who have followed the work of President Ballard and Executive Manager Aylesworth in getting the different state organizations interested in the geographic division plan.

The 1920 convention will be a business convention. The times demand it. Discussion and action on such broad topics as fuel conservation, interconnection of large power systems, financing of public utilities, regulation by public service commissions and electrification of steam railroads not only affect the business of the central-station industry but that of the country at large. Mature reflection by central-station representatives on these questions, as well as on some 80 committee reports dealing with many phases of the industry, will undoubtedly make the Pasadena convention go down as the most epochal in its history.

Advocating the Jones-Reavis Bill

The Jones-Reavis bill, proposing to replace the present Department of the Interior with a Department of Public Works, is continuing to attract the attention of men of influence. An important feature about it is that attention is generally followed by support. A bulletin from the New York office of the National Public Works Department Association says that already all of the Republican candidates for the presidency have indorsed it. Other bulletins have stated that several governors have indorsed it, among whom is Governor Lowden of Illinois, whose indorsement is particularly important because of his peculiar knowledge of the value of a department of public works in a government organization. Having applied the principle of such a department in a state government and then having observed the economies that it makes possible in conducting public work, Governor Lowden now indorses the principle for the national government.

No better argument, if one were needed, that a public works department is a desirable part of a government organization can be adduced than that it has been successful in introducing measurable economies in the functions of the Illinois state government. If further argument be required, then it is only necessary to repeat that every stable government of a civilized nation in the world, except the United States, has a department of public works, in effect at least, if not in name. Fortunately no proof is required that the creation of a national department of public works would be desirable. Engineers have shown business men of the country that its creation will reduce taxes by conserving appropriations and eliminating waste. It now remains to convince Congress that the country wants the department created. This can be done if the present agitation for the department is continued.

Terminal Inefficiency and Increased Freight Rates

The managers of eastern railways have presented figures to the Interstate Commerce Commission to show that a 28% increase in freight rates is necessary to provide for the proper development of the various railways. To substantiate their demands they exhibited statistics showing the disproportionate increases in revenues and expenses that have occurred since 1916, the ratio between operating expense and revenue increasing from 67% in 1916 to nearly 100% in 1920. Revenue and expense figures were, of course, itemized and are undoubtedly correct for the years specified. But one who is in any way familiar with the way in which freight is handled by the railroads wonders

whether or not the figures will apply to the future. If they will, the managers will stand accused of consummate incompetence; if they will not, the railroads will not need the 28% increase that is asked.

The managers probably have presented all of the items that can be included in expense data. One wonders, however, if they have presented all of the items of anticipated revenue. Nothing appears in the way of anticipated income resulting from improved methods of handling freight at terminals. Possibly one should expect to find this item in the expense column. If so, it is difficult to understand why expenses of operation in succeeding years should be much larger than they are at present. One means by which the cost of transportation can be reduced is by the application of electrically operated labor-saving machinery and devices in terminals. This means the managers have been slow to adopt. Studies by terminal engineers have shown that, in general, terminal charges are as much as 45% of freight charges. In many instances the terminal charges are larger than haulage between terminals even when the terminals are widely separated. But these large terminal costs are unnecessary and can be reduced by a little judicious planning on the part of the managers.

Every one interested in national development is interested also in seeing the railroads receive adequate return for service rendered. But if the service is to be rendered in the slip-shod and uneconomical fashion that has characterized it heretofore, no one can protest if the Interstate Commerce Commission concludes that part of the 28% increase should be derived from the application of efficient methods in freight terminals. To permit the present terminal inefficiency to continue while the roads pay dividends will be to permit the continuance of a tax on industry that is inexcusable.

Water-Power Bill Makes Progress in Congress

The recent adoption of the conference report on the water-power bill by the House of Representatives by a vote of 259 to 30 is an encouraging sign. It is believed that the Senate will soon take action on the bill and adopt it by an equal, if not more, decisive vote than did the House.

The bill has been hanging fire in the conference committee for a long period, mainly through discussion of relatively minor details in the wording of the bill. One objection was over a provision in the original bill providing for the appointment of a United States engineer officer as executive secretary of the federal power commission, but this was overcome by a change in the bill providing that the commission "may" request the services of an engineer officer whose duties will be prescribed by the commission. Another clause in contention was one permitting discrimination in favor of a municipality as against other users of the developed water power. This clause was eliminated entirely in the final adoption of the bill by the House.

As soon as the Senate has taken favorable action on the bill, prevailing opinion being that there is no question but that the Senate will take such action, decided impetus will be given water-power developments in all parts of the country and in the near future millions of horsepower in water power now going to waste will be utilized for the generation of electrical energy with a resultant conservation of coal and other fuels.

Palliative and Curative Medicine

Medical science has taught that the superficial treatment of the effect of an underlying cause may relieve a patient's mental indisposition, but it does not contribute anything to his recovery. The only treatment that is worth while when disease has made its appearance is that which fights the disease itself—the cause—and recognizes the symptoms or effect only for the purpose of making a proper diagnosis. Hence the saying that the most impalatable medicine is, after all, the best. The physician who would treat carcinoma with salve rather than a knife would be generally condemned, although the salve treatment might be more to the liking of the patient than the knife. What medical science has taught about the physical body and its ailments, political science has taught about the political composite. The lesson is that when a political illness exists, it had better be amputated than palliated. The question can be asked with some justification whether or not the overall parades are not palliative treatments.

Everyone admits that profiteering is one of the ailments from which the body politic is suffering and that the situation is particularly aggravated because the profiteering applies to the necessities of life. Did it apply only to luxuries, a short abstinence from purchasing them would relieve matters. Since people cannot exist without necessities, something more than abstinence is necessary. A prescription for the unnatural condition that exists is not necessary to be stated here. But it should propose a more serious treatment than one requiring only superficial application. It would seem that, however well intended, inducing people to indulge in overall parades is only a palliative treatment for an internal illness.

CURRENT EVENTS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

UTILITY INVESTMENT IN ILLINOIS IS OVER A BILLION DOLLARS.

Public Utilities Are Rapidly Taking Place Among Leaders in Industry—275,000 Owners of Utility Stock in State.

Illinois development of utilities in recent years has been along lines that have amply cared for industry as it expanded, the development of the state's central-station power plants having been particularly noteworthy despite the difficulty in obtaining financial aid for needed extensions and improvements during the past year or more.

Recently the Illinois Committee on Public Utility Information reviewed utility development in the state and found that $1,200,000,000 of capital had already been invested in the state in electric, gas, electric railways and telephone equipment, and that budgets for expansion over the coming five years totaled an additional $450,000,000. The committee found that there are approximately 275,000 direct owners of public utility securities living within the state, not taking into consideration the large holdings of banks, insurance companies and other such institutions, which probably gives an indirect ownership to nine out of every ten persons.

The large number of "customer owners," growing at the rate of about 5000 to 10,000 a month, is an answer to any reflection that might be cast on the state as to whether radicalism is liable to make headway in Illinois, as these owners constitute a voting strength that the agitators or unscrupulous politician would have to contend with.

The country at large was recently given a slight idea of the extraordinary development of the utilities of Illinois when it was announced that the Central Illinois Public Service Co., operating in the central and southern portions of the state, had "hooked up" the last link in a high-power transmission line which is now 1355 mi. long and joins the four states of Illinois, Kentucky, Indiana and Iowa. This single line crosses 31 counties. It starts at the hydro-electric development at Keokuk, Ia., crosses Illinois to Paris, Ill., and from that point runs east to Terre Haute, Ind., thence south to Edwardsville, Ind., and on down to Louisville, Ky. The transmission line has made possible the abandonment of scores of small town plants that were inefficient.

There are a number of other such central-station developments in the state, as can be gauged from the fact that 13 companies alone serve 662 communities. In the Chicago and Northern Illinois districts are the Commonwealth Edison Co. and the Public Service Co. of Northern Illinois serving 90 communities, outside of Chicago. In the Fox river district the Western United Gas & Fuel Co. serves 63 cities and towns. In the southern end of the state the Southern Illinois Light & Power Co. gives services to 40 communities, and in the Peoria district the Central Illinois Light Co. takes care of 40 or more towns.

The above are but a few of the developments that have resulted from private enterprise in the state and the labors toward economy in operation and conservation of fuel resources. So complete is the "wiring" of the state becoming that were the lines drawn on a map they would resemble a spider's web. Service has long passed the stage of local limitations in Illinois and has become a state and even an interstate matter.

EMMET TO RECEIVE EDISON METAL AT A. I. E. E. MEETING.

Presentation Made This Year for Inventions and Developments of Electrical Apparatus and Prime Movers.

At the annual business meeting of the American Institue of Electrical Engineers, to be held in New York City, May 21, the Edison Medal Association will present the Edison medal to W. L. R. Emmet, awarded to him this year for "inventions and developments of electrical apparatus and prime movers."

The object of the Edison medal, which is awarded annually by the institute "for meritorious achievement in electrical science, electrical engineering or the electrical arts," will be explained by Carl Hering, chairman of the Edison medal committee. The achievements of Mr. Emmet will be told by H. W. Buck and the medal presented by Calvert Townley, president of the institute.

At the business meeting preceding the presentation the board of directors of the institute will make its annual report for the year ended April 30 and the report of the tellers will also be presented, giving the results of the election of officers for the ensuing administrative year.

PREDICTS EARLY ELECTRIFICATION OF CALIFORNIA RAILROADS.

That the scarcity and high price of fuel oil will soon compel electrification of California steam railroads is the opinion of J. E. Woodbridge, a consulting electrical engineer of San Francisco. He develops his reason for the prophecy in a paper on "Fuel Prices and Railroad Operation" to be presented at the convention of the Pacific Coast Section of the National Electric Light Association at Pasadena, Cal., May 17.

Among the papers to be read at this meeting are several by Pacific Gas & Electric Co. employes, including "Internal Combustion Engines vs. Central-Station Power," by R. E. Fisher;

"Economic Use of Galvanized Steel Wire Instead of Copper," by J. P. Jollyman; and "A Report on the California Electrical Co-operative Campaign," by L. H. Newbert.

Interior valley problems to be discussed include "Storage for Irrigation and Power," by E. B. Walthall, and "Electricity in the Development of Oil Lands," by R. A. Balzari.

Among other papers of general interest to be presented are "An Analysis of the Possible Greater Use of Electric Power in the Beet Sugar and Other Industries," by J. O. Case; "An Account of Electric Furnace Installation in California," by W. M. Shepard, and "A Discussion of Power Factor and Rates," by E. A. Quinn.

TOUR DE LUXE ON RED SPECIAL TRAIN TOUCHES SCENIC SPOTS.

N. E. L. A. Convention Visitors Will Travel 8731 Miles on 30-Day Trip to Pacific Coast Points and Return.

So great was the demand for accommodations on the "Red Special" train that will carry visitors to the National Electric Light Association annual convention at Pasadena next week, including side trips to points of scenic interest both on the outgoing and returning trips, that it was found necessary to make the train one of nine Pullman compartment cars.

The "Red Special" left New York City Wednesday, May 12, at 5:30 p. m., arriving in Chicago at 4 o'clock the following afternoon and leaving three hours later over the Santa Fe railroad for Kansas City and thence westward over the southern route, the first stop for sightseeing being on Saturday afternoon, May 15, when an hour and a half was spent at the Harvey museum, Albuquerque, N. M.

Sunday, May 16, will be spent by the tourists in visiting the Grand Canyon of Arizona, while on Monday three hours will be devoted to a trip to the Mission Inn at Riverside, Cal. Pasadena will be reached at 5 o'clock Monday night, May 17. The tourists will remain in Pasadena attending the convention and sightseeing until Monday, May 24, when they will start on their trip northward along the Pacific coast, visiting Los Angeles, Santa Barbara and Del Monte, a full day being allotted for the latter city. Wednesday and Thursday, May 26 and 27, will be spent in a tour of the Yosemite Valley. San Francisco will be reached Friday morning, May 28, a stop-over of two days having been arranged for the Pacific coast metropolis. Shasta Springs, Portland, Ore.; Seattle, Wash.; and Vancouver, B. C., will be visited in order. Stops will be made at Revelstoke, Lake Louise, Banff Hot Springs, Winnipeg, St. Paul and at Chicago on the return trip to New York City, which will be reached June 11. The special train will be kept intact during the entire trip and beside the Pullman compartment cars will have a club car for the men and an observation car that will be known as the "Ladies' Red Special Club Car."

The list of those who have made reservations for the 30-day trip follows:

A. R. Granger and wife, Delaware County Electric Co., Chester, Pa.; William S. Megonigal and wife, Carl D. Bucholz and wife, George R. Green and wife, W. H. Johnson and wife, H. C. Albrecht, K. W. Kerford, F. A. Birch, Philadelphia (Pa.) Electric Co.; David Darlington and wife, H. C. Schlegel and wife, A. L. Holme and wife, W. H. Lawrence, Adolph Lieb, J. W. Lieb and wife, New York (N. Y.) Edison Co.; H. G. Kessler and wife, Hodenpyl Hardy & Co., New York City; H. D. Savage and wife, Pulverized Fuel Equipment Co., New York City; F. W. Sanford, Edison Lamp Works of General Electric Co., Harrison, N. J.; E. P. Edwards, J. R. Lovejoy and wife, General Electric Co., Schenectady, N. Y.; H. H. Barnes, Jr., General Electric Co., New York City; C. B. Burleigh and wife, C. B. Davis, General Electric Co., Boston, Mass.; S. E. Doane and wife, Miss Dorothy Doane, Miss Flora Morrison, G. S. Merrill and wife, National Lamp Works of General Electric Co., Cleveland; George W. Provost and wife, Union Electric Co., Pittsburgh; Mrs. F. A. Scheffler, Miss L. Scheffler, Mrs. C. A. White, Fuller Engineering Co., New York City; R. T. Lozier, National Conduit & Cable Co., New York City; J. M. Wakeman, Society for Electrical Development, New York City; H. A. Coles, wife and son, Westinghouse Electric & Manufacturing Co., Atlanta, Ga.; Judge D. Kenefick, Charles R. Huntley, Buffalo (N. Y.) General Electric Co.; William Schmidt, Jr., and wife, W. T. Biedler, Consolidated Gas, Electric Light & Power Co. of Baltimore; G. W. Elliott, wife and son, A. J. Marshall and wife, Miss L. Bioni, Miss M. Topka, Miss G. Burkhalter, National Electric Light Association headquarters, New York City; John Mustard, wife and son, Wagner Electric Manufacturing Co., Philadelphia, Pa.; J. W. Perry and wife, H. W. Johns-Manville Co., New York City; T. C. Fales and wife, Boston, Mass.; A. E. Silver and wife, Electric Bond & Share Co., New York City; August Mandel and wife, John Y. Parke Co., Philadelphia, Pa.; Dudley Farrand and wife, Miss Laura Jean Farrand, Mrs. O. N. Wright, N. A. Carle and wife, W. K. Vanderpoel and wife, Public Service Electric Co., Newark, N. J.; F. A. Stratton and wife, Westchester Lighting Co., Mt. Vernon, N. Y.; G. R. Trumbull and wife, H. L. Doherty & Co., New York City; E. A. Schroeder and wife, F. Schroeder Hair Felt Co., Newark, N. J.; E. A. Rumsey and wife, Rumsey Electric Co., Philadelphia; W. P. Schwabe, Northern Connecticut Light & Power Co., Thompsonville, Conn.; E. H. Noyes, Aluminum Co. of America, Chicago; W. Goodwin and wife, M. S. Seelman, M. S. Sloan, Brooklyn (N. Y.) Edison Co.; G. E. Andrews, A. D. Blake, W. H. Onken and wife, McGraw-Hill Co., New York City; T. N. Schulz, Municipal Electricity Works, Kristiana, Norway; E. C. Cook, New York Central & Hudson River Railroad Co., New York City; F. W. Smith and wife, United Electric Light & Power Co., New York City; W. H. Atkins and wife, I. E. Moultrop and wife, D. Goss and wife, Edison Illuminating Co. of Boston; Ray Palmer and wife, New York & Queens Electric Light & Power Co., New York City; A. A. Brown, Westinghouse Electric & Manufacturing Co., New York City; R. M. Campbell, Habirshaw Electric Cable Co., New York City; G. H. Thamer, George B. Leland and wife, Stamford (Conn.) Gas & Electric Co.; E. M. Graham and wife, Bangor (Me.) Railway & Electric Co.; J. T. Day, Malden (Mass.) Electric Co.; W. R. Eaton, Cambridge (Mass.) Electric Light Co.; W. K. Archbold and wife, Archbold-Brady Co., Syracuse, N. Y.; A. Anderson and wife, Municipal Gas Co., Albany, N. Y.; G. W. Lawrence, H. W. Lawrence, Turners Falls Power & Electric Co., Boston; T. H. Yawger and wife, Miss M. Palmer, Rochester Gas & Electric Corp.; Miss J. Miller, Brooklyn, N. Y.; F. A. Snow and wife, Boston, Mass.; E. A. Barrows, S. B. Swan, Narragansett Electric Lighting Co., Providence, R. I.; D. W. Beaman and wife, New Bedford (Mass.) Gas & Edison Light Co.; Edward C. Cooke and wife, Pawtucket, R. I.; F. D. Gordon and wife, Androscoggin Electric Co., Lewiston, Me.; A. R. Gould and wife, Maine & New Brunswick Electrical Power Co., Presque Isle, Me.; G. G. Bonner and wife, Alliance (O.) Gas & Power Co.; R. W. Rollins, Worcester (Mass.) Electric Light Co.; Charles A. Miller, Okonite Co., New York City; P. Junkersfeld, G. H. Muhlfeld, Stone & Webster, Boston, Mass.; M. J. Insull, Middle West Utilities Co., Chicago; Harry Reid, Kentucky Utilities Co., Louisville, Ky.; A. C. Marshall and wife, P. J. Savage and wife, R. W. Symes and wife, J. D. Jacobus and wife, A. J. Duke and wife, H. A. Snow and wife, H. Silvester and wife, Detroit Edison Co.; J. B. Johnson and wife, Lorain County Electric Co., Elyria, O.; Paul Stewart and wife, Paul Stewart & Co., Cincinnati, O.

ORVILLE WRIGHT IS RECIPIENT OF JOHN FRITZ MEDAL.

Sixteenth Award for Honors in Engineering Science Is Made for Achievements in Development of the Aeroplane.

Orville Wright was awarded the John Fritz medal at a meeting held in the Engineering Societies building, New York City, May 7, he having been selected as the recipient of the medal this year for his achievements in the development of the aeroplane. At the presentation addresses were made by Maj.-Gen. George O. Squier and Col. Edward A. Deeds, formerly head of the aircraft production board, while Comfort A. Adams, past president of the American Institute of Electrical Engineers, presented the medal to Mr. Wright.

The John Fritz medal is awarded annually to a person who has distinguished himself in some branch of engineering science and was established in 1902 in honor of John Fritz, Bethlehem, Pa. Since that date 15 medals have been awarded to prominent engineers. The members of the board of award consist of four representatives from each of the four national engineering societies, including the civil, mechanical, mining and electrical founder societies.

CHICAGO SECTION, A. I. E. E., HEARS TALK ON CITY BUILDING.

J. R. Bibbins, supervising engineer of the Arnold Co., Chicago, was the speaker at a joint meeting of the Chicago Section, American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers, having as his subject "City Building and Transportation," in which he explained the problems of transportation in connection with city planning work. The meeting was held May 12 at the Chicago Art Institute building.

HUGE NORTHERN JERSEY POWER PLANT IS PROGRESSING.

Plans for the organization of a $25,000,000 corporation, the North New Jersey Power Co., to supply electrical energy for power purposes to manufacturers and other large consumers in New York City and vicinity, have progressed so far that the establishment of the plant is said to be assured. It is expected that the work of construction will be begun within a month. The project is supported by the Public Service Electric Co. of New Jersey, of which Thomas N. McCarter is president, and a group of Newark, N. J., bankers headed by Uzal H. McCarter, president of the Fidelity Trust Co. of Newark.

LOUISIANA ENGINEERS DISCUSS TRANSMISSION LINES.

At the May meeting of the Louisiana Engineering Society, held in New Orleans, La., May 10, William Crooks, Pine Bluff, Ark., read a paper on "Transmission Line Construction," in which he explained the modern developments in that work.

COOPER HEWITT ELECTRIC CO. SHOWS INCREASE IN SALES.

Since control of the Cooper Hewitt Electric Co., Hoboken, N. J., was assumed last June by the General Electric Co., Schenectady, N. Y., new business of the company has more than doubled. The plant has been running to capacity and working overtime in an effort to catch up with orders.

In order to meet the increased demand for industrial lighting outfits as well as motion picture apparatus, the company has recently purchased some adjoining property. This will eventually give more than double the present floor space.

Rapid strides have been made in the improvement and development of the Cooper Hewitt lamp, chief among which is the standardization of the new 85% power-factor outfit. Some radical improvements are under way which will materially increase the efficiency of this lamp. The engineering and sales departments have been materially increased by the acquisition of new men.

BUREAU OF STANDARDS ISSUES A PAPER ON COPPER BRITTLENESS.

The Bureau of Standards, Washington, D. C., has issued technologic paper No. 158 by Henry S. Rawden, physicist, Bureau of Standards, and S. C. Langdon, professor of chemistry at the Northwestern University, on "A Peculiar Type of Intercrystalline Brittleness of Copper." An abstract of the paper shows the following points: A copper rod used as a cathode in a bath of molten sodium chloride, mild steel being the anode, with an e.m.f. of approximately 6 volts, was embrittled to a very appreciable extent. No embrittlement occurred when the copper was the anode of a similar set-up. The change of microstructure, which occurred in the first place, suggests that metallic sodium is formed by electrolysis which alloys with the copper along the boundaries of the crystals and so induces the brittleness observed. The results throw some light upon brittleness of copper wire and rods which sometimes occurs in commercial practice in the annealing in a bath of fused salt if the copper is in contact with iron or a similar metal.

COMING CONVENTIONS.

National Electric Light Association. Annual convention, Pasadena, Cal., May 18-21. Headquarters, Hotel Huntington. Acting secretary, S. A. Sewall, 29 West 29th street, New York City.

Missouri Association of Public Utilities. Annual convention, Jefferson City, Mo., June 3-5. Secretary, F. D. Beardslee, St. Louis, Mo.

North Central Geographical Division of National Electric Light Association. Annual convention, Minneapolis, Minn., June 16-17. Headquarters, Radisson Hotel. M. Barnett, Northern States Power Co., St. Paul, Minn., secretary.

Iowa Section, National Electric Light Association. Annual convention, Colfax, Ia., June 23-25. Rex H. Clark, assistant secretary, Des Moines, Ia.

American Institute of Electrical Engineers. Annual convention, White Sulphur Springs, W. Va., June 29-July 2. Headquarters, The Greenbrier, F. L. Hutchinson, secretary, 33 West 39th street, New York City.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 13-16, Secretary, D. L. Gaskill, Greenville, O.

Pacific Coast Section, American Institute of Electrical Engineers. Annual convention, Portland, Ore., July 21-23.

Michigan Section, National Electric Light Association. Annual convention, Ottawa Beach, Mich., Aug. 24-26. Headquarters, Hotel Ottawa. Herbert Silvester, secretary-treasurer, Ann Arbor, Mich.

National Association of Electrical Contractors and Dealers. Annual Convention, Baltimore, Md., Oct. 6. W. H. Morton, secretary, 110 West 40th street, New York City.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

SERVICE EXTENSIONS DEPEND ON ABILITY TO BORROW FUNDS.

Illinois Utility Companies Issue Statement to Public Showing What Must Be Done to Aid Present Situation.

Unless the utilities of the state of Illinois are placed in such financial position through adequate prices for service that they can enter the money market and compete with the high interest rates being offered by unregulated industries, Illinois cannot expect to have done $100,000,000 of new development work, necessary to keep pace with normal development, and service can not be improved. This ultimatum is served on the public in a report issued by a joint committee of the Illinois State Electric Association, Illinois Electric Railways Association and Illinois Gas Association, just made public. The committee has spent several months investigating the situation to ascertain what conditions are necessary so as not to impede development of the properties used in the public service.

"If a fair rate of return is denied, all thought of further investment in the industry must be abandoned," says the report. "Whether or not a utility can present proper inducements to the investing public to attract capital depends primarily on the measure of return which public regulatory authorities are willing that the property should earn. The fair measure of a necessary rate of return in comparison with the rate of return paid by other industries is the cost of money to other industries and the return to the utility must be at least as great and safe as it is to other industries. The rate of return which was reasonable prior to 1914 is not reasonable today, and the cost of money is not likely to recede materially in the next few years."

As to the effect of failure to obtain the necessary new capital upon business men and manufacturers of all communities, the committee says:

"Cities and communities thrive and prosper only as their public utilities are able to expand to meet the increased demands made upon them. Today every progressive city in Illinois and in other states is demanding more and better service from its public utilities. The expansion and extension of present facilities necessary to meet this demand require the investment of large amounts of new capital. Failure to secure this vast amount of new capital will materially retard the normal growth and development of these communities. It is axiomatic that two things must obtain to encourage the necessary investment in public utility securities: First, a fair valuation of the property; second, rates for service sufficient to pay, over and above expenses, an adequate return. To establish the credit of public utilities so that their securities may be sold in competition with the securities of other industries, it is absolutely necessary that the rates fixed be just and reasonable as compared with rates which are merely non-confiscatory."

URGES AMERICANS TO BECOME PARTNERS IN BIG BUSINESS.

"Formerly securities were regarded by many as only for the wealthy; today the poor man, too, is laying aside a little nest-egg for wise and safe investment," says the New York *Sun*, commenting upon the large numbers who are now buying securities of companies selling essential products, such as the public utilities.

"Even more important than the fostering of habits of thrift," says the article, "is the democratizing of American industry which this movement tends to effect. With the multiplying of shareholders the great corporations become no longer things apart from the people, things in which they have no share, and for which they entertain a kind of vague dread and hostility. The man in the street becomes now a partner with big business, sharing in its prosperity and suffering with it when misfortune comes.

"It is hoped that this movement will acquire increased momentum. It offers the logical solution to the long vexed problem of the so-called dangerous trusts, a solution far better than that of hampering and crippling them by unwise legislation. Let the American people become partners of big business and all danger will vanish in a flash."

WISCONSIN COMMISSION RULES IN METER RATE CASE.

Says Metered System in Some Cases May Save Installation of New Equipment to Handle Electric Lighting Load.

In granting the application of the Hayward Electric Light & Power Co., Hayward, Wis., for authority to withdraw its present commercial power schedule, which was on a flat rate basis, and to substitute therefore a metered schedule, the Wisconsin Railroad Commission made the following ruling:

"The advisability of changing from a flat rate to a metered rate as a general proposition has always been upheld by this commission as a matter of equity. That a customer should pay for service in proportion to the amount or value as well as the cost of the service rendered is a well-established principle. Under the flat rate a customer who uses his installation only occasionally must pay the same rate as one who uses his installation continuously, if both installations are the same size. If, then, the total revenue from all the customers is in proportion to the cost to the company of the total energy furnished the short-time user must pay many times his proper

share and the long-hour user much less than his fair proportion.

"There is, moreover, no incentive toward economy in the use of energy under the flat rate. This is to the utility a very important consideration both on account of cost of this extra generation and on account of loading down of the generating equipment which may mean the installation of additional equipment to take care of new customers when under the metered system this might be unnecessary. Another consideration sometimes enters into the case of hydraulic plants. During periods of low water the water used in generation may exceed the stream flow, in which case the load must be cut off either in part or temporarily in entirety.

"In changing the schedule from a flat rate to a metered basis it is in most cases impossible to determine the result of the new rate. Even if an analysis of the uses of the customers is made by metering the energy used prior to the billing under the new rate and the rate devised on the basis of this analysis, the care taken to decrease the cost by the consumer will, when the metered rate is installed, result in a loss of revenue."

POWER SHORTAGE IN CALIFORNIA SOON TO BE RELIEVED.

State Power Commissioner Predicts 1920 Will Be Last Short Year as Far as Supply Is Concerned.

In an address on "The Power Situation in California," made recently before the San Francisco Electrical League, H. G. Butler, state power commissioner, gave figures that showed the expected power shortage this year would not exceed 10% instead of the 25% previously estimated and made a prediction that the present year will be the last there will be of a shortage as far as water power is concerned.

Figures were presented to show the percentage of run-off from the various power streams in California during the period from October, 1919, to February this year, the percentages being reckoned from normal. In northern California the Pitt river made the best showing with a run-off of 58% against 33% recorded for the Feather river, 22% for Yuba and 15% for the American river.

Mr. Butler spoke of the great tie-in of transmission lines stretching from southern Oregon to the Mexican border and which needs but the completion of a line to fill a gap of 18 mi., joining the systems of the San Joaquin Light & Power and the Pacific Gas & Electric companies, to make an uninterrupted chain of high-tension lines bearing the energy on its mission of usefulness. This tie-in will enable the power companies to help each other out as the demands upon them may require. At the same time, the pressing need is for more hydroelectric power development and that in the immediate future. The present record shows a total of 42 electric power plants in the northern district of California, of which 33 are hydro and 9 steam, and 49 in the southern district, of which 34 are hydro and 15 steam; but important additions to these will materially raise the output figures.

The following list of new plants under construction with their capacities and expected dates of completion was given:

City of Los Angeles, 20,000 kw., San Francisquito Creek, No. 1 plant, June 1, 1920, No. 2 plant, July 1, 1920; San Joaquin Light & Power Co., 12,500 kw., Bakersfield, June 1, 1920; San Joaquin Light & Power Co., 30,000 kw., San Joaquin river (Kerchoff), Oct. 1, 1920; Southern California Edison Co., 16,500 kw., Big Creek (new unit), Nov. 1, 1920; Southern California Edison Co., 30,000 kw., Kern River No. 3, Nov. 1, 1920; Pacific Gas & Electric Co., 12,500 kw., Oakland, Nov. 1, 1920; Pacific Gas & Electric Co., 24,000 kw., Pitt River, Jan. 1, 1921; Los Angeles Gas & Electric Corp., 10,000 kw., Jan. 1, 1921; Southern Sierra Power Co., 2500 kw., Adams plant, Jan. 1, 1921; Great Western Power Co., 40,000 kw., Feather River (Caribou), March, 1921; Southern Sierras Power Co., 10,000 kw., October, 1921.

The need of this new construction was made apparent by the commission's estimates of impending demand for electric power. He estimated the demand during the summer of 1920 at 10,000,000 kw. per day, while the entire output of all plants in the state during 1919 was but three and one-third billion kw., so it was easy to see what effect a power shortage under the present conditions would have upon the progress and development of the state. Mr. Butler indicated the present physical conditions by a chart which showed the plants operated from base hydro, that is, by stream-flow without seasonal storage, those operated through storage reservoir systems and the steam electric plants in operation, with their capacities of output. From these and the estimated water conditions in the state he figured a shortage during the seven months' period between the present and the winter rains. From these calculations it was pointed out that it would be necessary to parcel out carefully the supply at hand, and that this would have to be done not only by changing the hours of demand, that is, from day to night whenever feasible but, also, that it would take very good luck all around to get through. Then he said:

"The best I can offer you is a 10% shortage. What that means can be understood when we recall that all of the various experiments adopted during the war, such as skip-stops on cars, cutting down the street and electric sign lighting, restriction of breweries and other manufacturing plants from one-third to one-half their normal supply of power, and the like, only served to cut down the use of power by 12%."

IRRIGATION ELECTRICAL DEMANDS SHOW INCREASE.

New impetus has been given to the demands for electric power for irrigation work in the district tributary to Pueblo, Col., recently. The Arkansas Valley Railway, Light & Power Co., of that city, has been receiving an increasing number of requests for extensions and at the present time is rapidly building new transmission lines to meet the demands. Electric power equipment is now being installed at ranches and industrial plants along the new lines ready to take advantage of the electrical power.

OPERATING PRACTICE

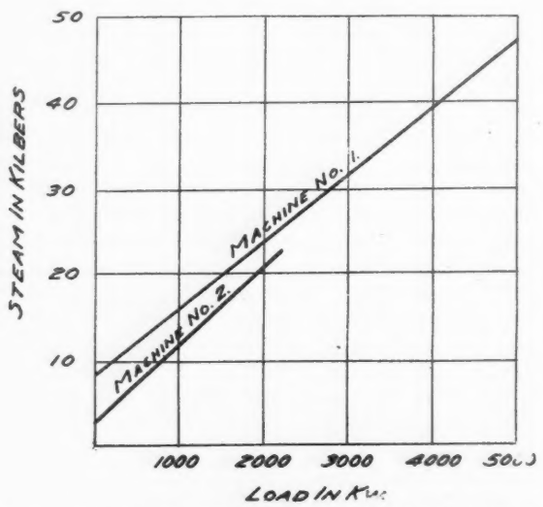
Methods and Problems Embracing Operation and Installation of Power-Plant Equipment and the Distribution of Electrical Energy

BOILER-ROOM OPERATION GUIDED BY TURBINE CURVES.

Method Described Whereby Boiler-Room Equipment Is Handled Efficiently and in Harmony With Generator-Room Operation.

A practical method of co-ordinating boiler-room and generator-room operation was described recently before the Technical League of the Milwaukee (Wis.) Electric Railway & Light Co. The method is one used by the Union Light & Power Co., St. Louis, Mo., and is based on the "Willans law."

In order that the boiler plant and the generating equipment be operated in harmony and at the highest possible efficiency, it was considered important that the operating men should know, half an hour in advance, what load was expected on the system. A chart was constructed showing the Willans total steam line for each size and type of machine in the plant. This chart was constructed, as shown in the accompanying illustration, with the load in kw., on the machine, plotted against kilbers (a kilber is a unit of 1000 lbs. of steam per hour). A



Typical Turbine Economy Diagram Used to Co-ordinate Turbine and Boiler Operation.

separate line is required for each type of machine because the various types have different steam economy.

The load operator, by referring to the load diagram of the day before and of the day a year before, determines the probable load to be carried on the system for the day. He decides which units should be used to carry the load during the various periods of the day, and, by an examination of his diagram, determines the amount of steam that will be required to carry the load on the selected units. The load operator keeps the boiler-room foreman informed, a half hour in advance, of all anticipated load changes. Thus, the boiler-room foreman can select the proper boilers to meet the system demands with the best economy.

It has been found that this method of operation assists materially in keeping the proper relation between boilers under steam and the load demand, and that real economies have been made. Corrections are required if the steam pressure or vacuum conditions do not remain constant.

CAUSTIC-SODA SOLUTION USED TO RESTORE SULPHATED BATTERY.

Use of Caustic Soda as a Solution Gives Better Results Than the Usual Overcharge for Sulphated Cells.

Sulphated storage-battery cells may be effectively renewed by charging the cells, using a solution of caustic soda instead of the regular sulphuric-acid solution.

In treating the sulphated cell by the caustic-soda method the acid solution is siphoned off in case of a large cell or poured off in the case of a small one that can be easily handled, and the plates are thoroughly rinsed or soaked in distilled or rain water, which is again drained off. A solution of high-grade caustic soda (NaOH) of a strength running from 2 to 5% by weight is poured into the cell, using enough to cover the plates, and the battery is put on charge, charging in the usual direction and at the regular rate. If, at any time, the solution gives an acid reaction on litmus paper and the sulphate at the positive plate has not disappeared, caustic should be added to the solution until a positive alkaline reaction is given on the litmus paper. The charge should be continued until the plate has the usual chocolate appearance. The solution should then be drawn off, the plates rinsed, the sulphuric-acid solution poured back, and the charge continued until gassing starts or until the voltage drop shows the cell is fully charged.

The users of this method of treatment for sulphated cells claim to secure more satisfactory and lasting results than can be secured by the common practice of overcharging.

CORRECTION OF POWER-FACTOR WITH STATIC CONDENSERS.

Voltage Regulation Is Improved and Power-Factor Raised to Satisfactory Values by the Installation of Static Condensers.

By Edward A. Roeser.

Low power-factor is one of the items limiting the capacity or output of an a-c. distribution system or generating station. Since low power-

factor reduces capacity and, consequently, the possible return on a given investment, it has been the object of attack from many different sources and angles. Power-factor is a flexible quantity and, therefore, is subject to improvement, which may be accomplished by a careful selection of motor equipment so that each unit carries as near full load as practicable, by synchronous motors used as condensers and by the use of static condensers. The first two methods are commonly used and the third method is now attracting wide attention.

In many industrial plants the demand for power supply has resulted in over-motoring, which is productive of low power-factor. If no inducement is offered for power-factor improvement, naturally the results will not be encouraging, but, with an inducement presented to the consumer, his interest is awakened and if his interest reflects in an economy he will seek apparatus which will improve his operating conditions. Many central-station companies now offer inducements, particularly to their larger customers, to maintain a high power-factor. These inducements take different forms, but are all aimed to secure a power-factor, on lines and generating equipment, as near 100% as possible.

Many progressive concerns have made improvements under practical operating conditions by rearranging equipment in such a manner as to

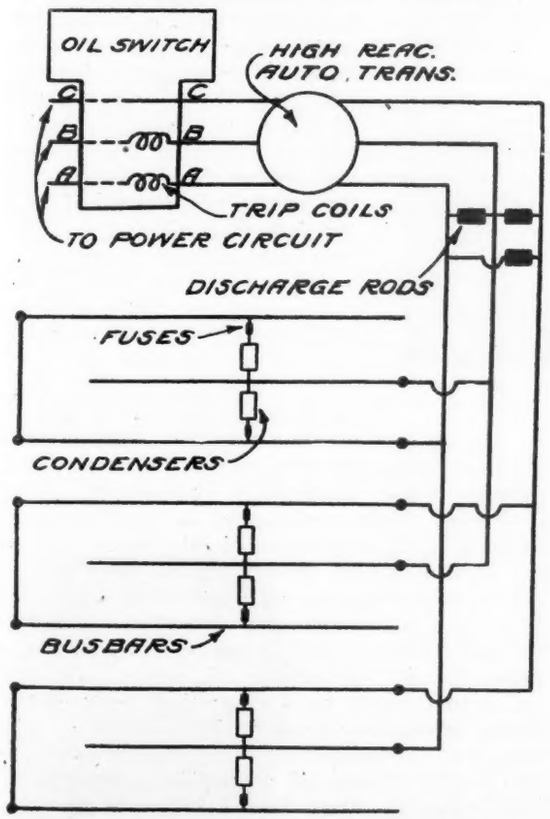


Fig. 1.—Diagram of Static Condenser Connections as Used in the Rochester Motors Co. Plant.

increase operating efficiency as well as power-factor. These improved conditions are commendable, but do not always entirely accomplish the results desired. In factories where large motors are used for steady loads, synchronous motors may be advisedly employed. Within reasonable limits it is fair to say that a kv-a. of power-factor correction in a synchronous motor is cheaper to furnish than a kv-a. in any other form of corrective equipment. However, skilled attendance is generally required to be sure that the proper amount of corrective effect is being

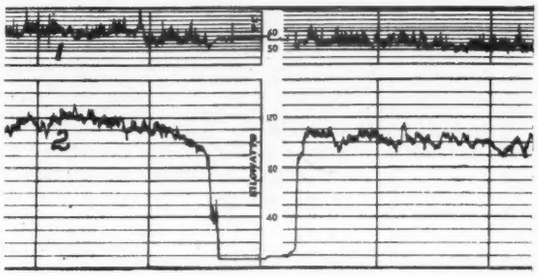


Fig. 2.—Recording-Meter Chart Showing Load and Power-Factor Without Condensers.

supplied. One of the important factors against the use of synchronous motors is their first cost as compared with that of induction motors. The chief factor, however, seems to be that the necessity for power-factor improvement is never seriously considered until a low power-factor condition becomes serious, whereupon remedies are sought rather than preventives. For such cases, which are prevalent, the static condenser is in a position to be considered as a remedial agent without interfering with the plans for motor drive.

In its present form the static condenser is quite expensive as compared with a synchronous motor. However, it possesses a number of advantages which are worthy of careful consideration. The only attendance required is that for operating the oil switch at the beginning and close of each day, and this can be eliminated if it is found desirable to allow the condenser to run for 24 hrs. a day, or by the arrangement of a suitable control relay connected to a solenoid-operated oil switch. A constant corrective kv-a. is supplied to the line by the static condenser, thus satisfying the conditions ordinarily encountered. There are no rotating parts and hence no brushes or bearings to be watched. The equipment may be installed in space not needed for manufacturing operations; in fact, suitable quarters would be in a sheet-metal house placed in the yard. The operating costs of the static equipment are low, and, if the problem is one of considering either a synchronous or a static condenser, the latter is the cheaper in most cases up to about 1000 kv-a. capacity.

A brief description of the apparatus, together with the accompanying diagrams and records, will show the manner in which the condenser functions and the results that are obtained. Each condenser unit is contained in a hermetically sealed can and is composed of a large number of thin aluminum sheets separated by insulating material and immersed in oil. The terminals are brought out through bushings and each unit is fused to the bus bars. The diagram shown in Fig. 1 illustrates the arrangement of a static condenser installation made in the plant of the Rochester Motors Co., Rochester, N. Y. This installation, which was made for experimental purposes, increased the power-factor of the

plant-load from 58% to 88% and so, incidentally, improved the voltage regulation and produced more satisfactory operating conditions generally.

The curves shown in Fig. 2 illustrate the relation existing between load and power-factor before the installation of the condenser. The curves shown in Fig. 3 illustrate the same relation after the condenser was installed. Examination of these two sets of curves shows the marked improvement made. The general average power-factor during the working day was increased from about 58% to about 88%. At noon when the motors are shut down, it will be observed, the power-factor reading increases to a limit set mechanically to prevent the pen from running off the chart and beyond the limits for which the instrument was designed. The power-factor actually goes beyond the zero point and assumes a leading value, thus serving to correct, at the generating station, a portion of the lagging power-factor of other loads.

By thus improving the power-factor, the so-called wattless current which circulated in the distribution system, doing no work except for its heating effect on the conductor and supplying a non-energy magnetizing load demanded by the motors, then circulates only between the load and condenser. If the motors are operating at light load the non-energy or magnetic demand is out

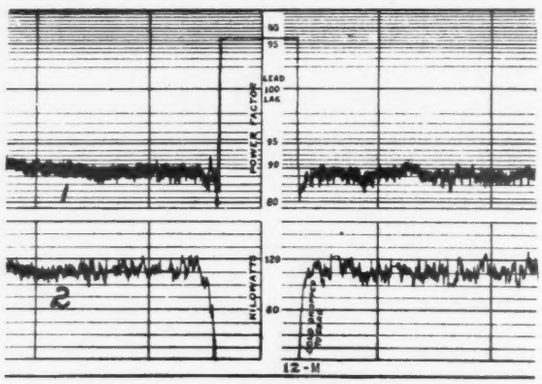


Fig. 3.—Recording-Meter Chart Showing Load and Power-Factor After Static Condenser Was Installed.

of proportion to the energy demand. Such conditions demand excess capacity in transmitting and generating equipment and it is for this reason that attempts are being made throughout the country to encourage power-factor improvement by means that are economical, reliable and efficient. The apparatus experimented with in the Rochester Motors Co. plant has been in continuous operation for nearly a year without trouble and may therefore be considered to be giving satisfactory operating service.

PROTECTIVE GROUNDING OF NON-CURRENT-CARRYING PARTS.

National Safety Council Gives Directions Relative to Grounding Under Various Conditions.

The National Safety Council, in a recent bulletin, presented an analysis of the conditions under which non-current-carrying parts of electrical equipment should be permanently grounded, and indicated the proper size of conductor to be used under various conditions.

It was stated in this analysis that permanent ground connections should be made to all exposed non-current-carrying metal parts, such as the frames of motors, cranes, cars and switchboards, cases of transformers, oil switches and wiring of all equipment utilizing over 150 volts, wherever such equipment is located; and of all equipment in all locations where explosives, inflammable gas or inflammable flyings (dust, lint, fumes, etc.) normally exist in dangerous quantities, regardless of the voltage involved.

It was also recommended that grounds be permanently made to all parts where exposed surfaces, such as metal frames of other machines, plumbing fixtures and conducting floors or walls, exist within the reach of persons when touching the metal parts under consideration. Usually surfaces within 5 ft. horizontally of the parts considered and within 8 ft. vertically of the floor are considered within reach. Except in the first two cases, no ground connection need be made to exposed metal frames of switchboards, motors or lighting fixtures connected to d-c. trolley or third-rail circuits, provided that such frames are effectively insulated from ground and provided that the metal frames in question are so located, with reference to insulating floors or platforms, that persons cannot readily touch the metal frames in question without standing on such floors or platforms. Furthermore, parts of machines such as nameplates, screws in wood and similar small parts which are not liable to become alive, except under very unusual circumstances, may be left ungrounded.

The ground wire for non-current-carrying parts should be made of copper of a size corresponding to the capacity of the nearest fuse or other automatic cut-out. Proper sizes of wire are indicated in the following table:

Capacity of Nearest Automatic Cutout Amperes	Size of Ground Wire, B. & S. Gauge.
100	No. 10
101 to 200	No. 6
201 to 500	No. 4
501 and above	No. 2

A No. 14 ground wire may be used for portable equipment that is protected by fuses whose capacity is not greater than 15 amperes.

Ground conductors should be run separately to the ground, or to a sufficiently heavy grounding bus or system ground cable which is well connected to ground at more than one place, from each of the following classes of equipment: Secondaries connected to low-voltage lighting or power circuits; secondaries of current and potential transformers and cases of instruments on these secondaries; frames of d-c. railway equipment and of equipment operating in excess of 750 volts; frames of utilization equipment or wire runways other than those covered by the last item above.

Non-current-carrying parts placed in separate classes and requiring separate ground connections are instrument-transformer cases, frames of d-c. railway equipment and other equipment operating in excess of 750 volts and frames of other utilization equipment. Lightning arrester ground connections should be made to separate grounds.

NEW APPLIANCES

Newly Developed and Improved Electrical and Mechanical Apparatus, Appliances, and Devices Now Being Placed on the Market

Extension Reel Lighing Unit.

Anderson Electric & Equipment Co., 118 South Clinton street, Chicago, has added to its line of extension reel lighting equipment the "Reelite," which is of the drop-cord type for flexible industrial lighting and for machine and bench work. It consists of a reel-unit 5.5 ins. in diameter, carrying 12 ft. of approved reinforced portable cord. The cord winder is of the plural spring type. The unit is equipped with a standard 250-watt key socket, and the base may be attached to any 3-in. outlet box. It is finished in black enamel, and is suitable for large or small installations.

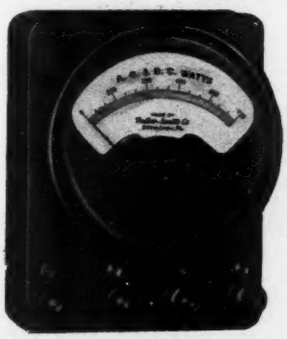
Reelite Flexible Unit.

Flexible lighting with this equipment permits of easy adjustment of the distance of the lighting unit from the work, since it is simply raised or lowered like an ordinary window curtain. Standard shades or reflectors can be attached to the sockets, and for horizontal lighting the cone or deep-bowl reflectors are satisfactory. The company has issued catalog No. 1533 descriptive of the unit.

Pocket-Size Portable Indicating Meters.

Roller-Smith Co., New York, N. Y., is marketing a line of pocket-size a-c. meters. They are made in a fairly large assortment of ranges and also are supplied with two or three ranges in a single instrument.

Electromagnet-type mechanisms are used in the voltmeters and ammeters, and electrodynamometer-type mechanisms are used in the wattmeters. Air damping and Ceylon sapphire jewels are used in all instruments. Voltmeters and ammeters are guaranteed accurate within 2% of full-scale values, and wattmeters are guaranteed accurate within 1.5% of full-scale values. The scales are 2.75 ins. long. Instruments for measurements above 150 volts require external resistances.



Pocket-Size Portable Indicating Meter.

Sunlight Units for Use With Existing Fixtures.

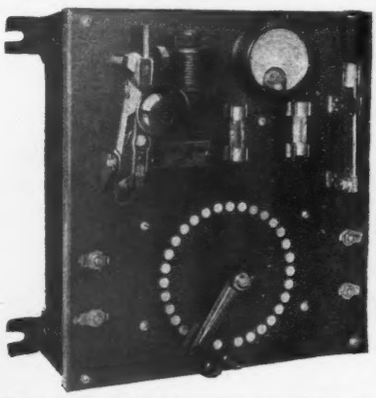
The Sunlight Electric Co., 54 Lafayette Blvd., Detroit, Mich., is marketing a line of lighting glassware under the name "Sunlight Units." These are made up of a reflector and a diffusing bowl, both made of moonstone glass. The diffusing bowl reflects a portion of the light up to the reflector, in addition to diffusing a portion directly. The reflector diffuses a portion of the light as well as reflecting a portion. The two parts of the unit are connected together by means of special connectors, without drilling the glass. Good diffusion with low absorption factor is claimed for these units, which are made to be attached to a standard 2¼-in. shade-holder and can be installed on existing fixtures.

Sunlight Unit.

Charging Panel for Portable Storage Batteries.

For charging secondary batteries used for electric lighting, starting and ignition on gasoline cars, the Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has developed the new charging equipment, shown in the accompanying illustration. This equipment is to be used with a d-c. source of supply. The charging set consists of a slate panel mounted on a wall-type frame and carrying a low-current cutout, single-pole main-line knife switch and fuses, ammeter and 30-step rheostat, and is capable of charging any number of cells in series, from 3 up to 42 or the maximum number that can be charged on the voltage of the circuit. The resistor is mounted in the frame back of the panel. The ammeter and knife switch may be omitted if desired, or the 30-step rheostat may be furnished alone or with an ammeter and double-pole fused knife switch.

The line lugs are on one side of the panel and the battery lugs on the other side. After line and battery connections are made for charging, the knife switch and low-current cutout are closed in succession and resistance is gradually cut out until the charging current is brought up to the right value, as indicated by the ammeter. Should the line voltage drop to a low enough value to cause the battery to discharge back into the line, the low-current cutout will automatically release, disconnecting the battery from the line.



Semi-Automatic Charging Panel for Storage Batteries.

The charge is terminated by opening the knife switch, which causes the low-current cutout to open and interrupt both sides of the charging circuit.

Portable Tilting Lamp.

H. S. McFaddin & Co., 38 Warren street, New York, N. Y., recently put on the market a portable lamp known as the Dresalite. This lamp is equipped with an adjustable shade which can be tilted or turned to throw the light in any direction. The fixture can be attached to the mirror frame, dresser or bed by means of two small screws.

Combination Switch and Receptacle Plate.

A new appliance recently put on the market by the Peerless Light Co., Chicago, Ill., eliminates the inconvenience of having switch and receptacles in different parts of a room. There is scarcely a room in a household in which outlets are not required to serve some convenient end, ranging all the way from the running of a washing machine to the manipulation of a curling iron. By this new device the labor of installation on such outlets is greatly reduced, the manufacturer claims.

Oil-Testing Transformer Set.

A small, compact, portable testing set, suitable for oil testing only, has recently been developed by the General Electric Co., Schenectady, N. Y. It consists of a main testing transformer having a high-potential winding for 25,000 volts, a control (auto-transformer) which may be arranged for either 110 or 220 volts at 25 to 60 cycles as specified, 110 volts being considered standard, and an oil-testing spark gap.

The testing transformer, having a

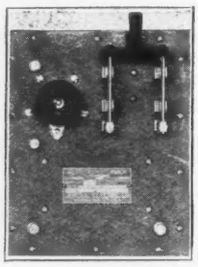


Fig. 1.—Oil-Testing Transformer Rated at 25,000 Volts.

ratio of 110 to 25,000 volts, has one end of its high-tension winding grounded. This transformer is of the oil-insulted type, encased in a sheet-steel tank with a composition cover tightly bolted to an angle-iron rim which is welded to the tank. The joint between the tank and cover is fitted with a gasket. The transformer weighs about 70 lbs., and is equipped with handles which make it easy to carry. The tank is fitted with lugs at the base so that it can be bolted to a bench or to the floor of an automobile truck. This outfit is designed for indoor service, but may be used outdoors if provided with a suitable cover.

The control consists of an air-cooled auto-transformer with regulating taps connected to a selector switch with dial to give 15, 17.5, 22.5 and 25 kv. on the

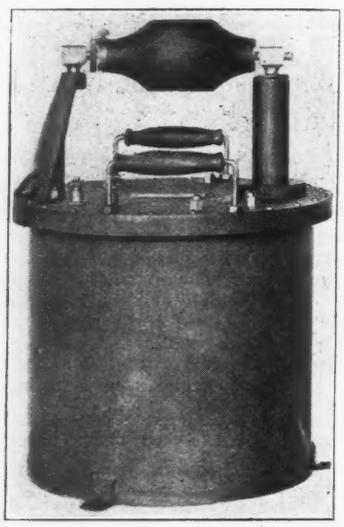


Fig. 2.—Auto-Transformer Control for Oil-Testing Set.

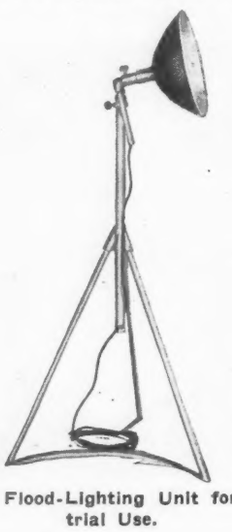
high-tension winding of the main transformer, and a double-pole step-resistance knife switch, which prevents wave distortion when the transformer is cut into the line. These devices are all mounted as a unit. A cord, with a plug for attaching to a standard Edison socket, is supplied for making connections with the control. Cables are also supplied for connecting the control and the main transformer.

The oil-testing spark-gap has been especially designed. It consists of a hard-rubber body molded in one piece, the electrodes being 1-in. discs with their shafts shrunk into the molded part. One electrode is made movable by rotating, and a gauge is provided for adjusting the spacing, which is locked by means of a set screw.

The test is carried out as follows. The gap is lifted from its supports and filled with a sample of the oil. It is then replaced on the supports, and, after the dial on the control has been set for 15 kv., the knife switch is closed and held for about 5 seconds. If the oil does not break down, the test is repeated with the control set on the higher points.

Industrial Flood-Lighting Unit.

The flood-lighting unit shown in the accompanying illustration has been developed by the Alexander Milburn Co., 1418 West Baltimore street, Baltimore, Md. It consists of a 15-in. enameled reflector mounted on an adjustable tripod. The reflector is mounted on a pivoted joint so that it



Portable Flood-Lighting Unit for Industrial Use.

may be set to any desired angle. The extreme height of the tripod when fully extended is 68 ins. The lamp can be lowered to illuminate areas under tables or benches near the floor. The unit is supplied with a 20-ft. length of armored cable. The manufacturer states that this unit will throw a beam of light for a distance of 60 ft. when equipped with a 100-watt tungsten lamp.

New 250-Watt Battery-Charging Outfit.

A new battery-charging outfit with a capacity of 250 watts has been placed on the market by the Hobart Bros. Co., Troy, O. The outfit is capable of recharging from one to four auto-starting and lighting batteries at one time. Though much smaller than others manufactured by the same company, it retains the same special features, such as ball-bearing equipment, automatic voltage control, allowing different voltage batteries to be charged at the same time, ample capacity for the rating and a complete panelboard mounted on top of the motor-generator set.

Electric Flatiron with Steel-Clad Heating Element.

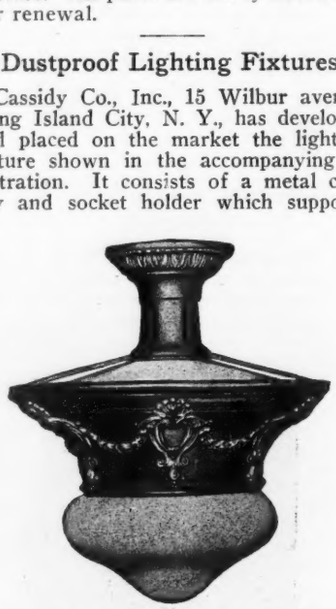
One of the features of an electric flatiron recently placed on the market by the Westinghouse Electric &

Steel-Clad Heating Element a Feature of New Flatiron.

Manufacturing Co., East Pittsburgh, Pa., is a substantial steel-clad heating element. This steel-clad element makes for an even distribution of heat at all times, something that is necessary for the production of good work with a minimum of effort. In addition, this flatiron is designed to have a pleasing appearance as well as durability of construction. It has easy lines, good finish, and a durable cord. The beveled edges on this flatiron make it suitable for work on delicate fabrics. All parts are easily accessible for renewal.

Dustproof Lighting Fixtures.

Cassidy Co., Inc., 15 Wilbur avenue, Long Island City, N. Y., has developed and placed on the market the lighting fixture shown in the accompanying illustration. It consists of a metal canopy and socket holder which supports



A Dustproof Fixture for Use With Gas-Filled Lamps.

a diffuser and a metal ring. The metal ring supports the diffusing glass bowl, and is provided in a variety of sizes and finishes. The socket holder is ventilated to dispose of a part of the heat generated by the lamp.

It is claimed that this fixture will overcome dust troubles. Each fixture is wired complete with a porcelain socket.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

Cleland, Inc., technical and trade advertising, has moved its New York City headquarters to larger quarters at 171 Madison avenue. John H. Van-Deventer, Harry E. Cleland and Edward F. Archibald comprise the membership of the company.

Locke Insulator Co., Victor N. Y., manufacturer of porcelain insulators, etc., has awarded a contract for the construction of a new plant at Baltimore, Md., estimated to cost approximately $500,000. It is understood that work on the erection of the initial units will be inaugurated at once.

Black & Decker Manufacturing Co., Baltimore, Md., manufacturer of air compressors, portable electric drills, etc., has completed arrangements for the establishment of a new branch manufacturing plant and salesroom at 318 North Broad street, Philadelphia. W. C. Allen is in charge of the Philadelphia establishment.

Diamond Power Specialty Co., Detroit, Mich., received orders during the first three months of the present year to equip boilers and economizers totalling 536,200 hp. with mechanical soot blowers. The company reports that 70% of the orders covered equipment for two or more boilers and that 57.7% were repeat orders.

Wico Electric Co., Chestnut and Liberty streets, Springfield, Mass., has completed negotiations for the purchase of a total of about seven acres of land at Western avenue and Bliss street, to be used as a site for the construction of a new plant. Details of construction are now being arranged. Phelps Brown is the president of the company.

Benjamin Electric Manufacturing Co., 806 West Washington boulevard, Chicago, Ill., is sending out leaflets calling attention to the "Benjamin" two-way plug and telling the benefits that can be derived from its use. The advantages of the "Benjamin" shade holder are also called to the attention of the dealer in one of the leaflets.

Beardslee Chandelier Manufacturing Co., Chicago, has issued a new booklet descriptive of the "Denzar" lighting unit, in which full details of the unit are given, together with illustrations of installations in stores and offices. The booklet has space on the back cover for the imprint of local contractor-dealers who sell the "Denzar" unit.

Landers, Frary & Clark, New Britain, Conn., manufacturer of electric devices, etc., have let a contract for the construction of a new 6-story reinforced concrete addition to its plant. The company has also had plans prepared for the installation of a new overhead carrier system for the distribution of molten metal from the cupolas to molders in the foundry.

C. F. Atherton Co., 184 West Washington street, Chicago, is sending to the trade a pamphlet describing "Atherton" transformers, in which the company lays stress on the fact that its transformers are built of aluminum, making them of rugged construction.

National X-Ray Reflector Co., Chicago, has devised a new method of packing its "X-Ray TruDa Seventy-Five" reflector that not only insures the reflectors reaching the retailer in proper shape but also gives him a carton that is handy for shelf and window display. Each reflector is

New Carton Used for Packing and Shipping National X-Ray Reflector Co.'s "TruDa Seventy-five" Reflector.

first packed in an individual container and for shipment eight of the small containers are packed in one large carton.

Habirshaw Electric Cable Co., 10 East 43rd street, New York City, reports orders booked in March totaling $1,568,969, and for the quarter ending March 31, amounting to $4,500,000.

Electric Storage Battery Co., 19th and Allegheny streets, Philadelphia, Pa., has awarded a contract to the William Steele & Sons Co., 1600 Arch street, for the erection of three 1-story buildings at Rising Sun avenue and Adams road, to facilitate operations.

McMullen Machinery Co., Grand Rapids, Mich., has formed a handling and conveying equipment department, which will specialize on electrical and pneumatic cranes and hoists, overhead systems, chain and belt conveyors, gravity conveyors and construction machinery. K. K. Hicks is engineer of the new department.

Electric Equipment Co., Walla Walla, Wash., will increase its capital stock from $25,000 to $75,000 in order to provide funds for handling the increasing business of the company in the distribution and sale of farm lighting systems and other electrical appliances in eastern Washington, Idaho, and part of Oregon.

Roller-Smith Co., 233 Broadway, New York City, announce the appointment of F. R. Ryan as district manager of its Chicago office, 739 Monadnock building. Mr. Ryan, who has been connected with the company's Chicago office since January, 1919, as sales engineer, is a graduate in electrical engineering of Notre Dame University and also attended the University of Illinois.

Bates Expanded Steel Truss Co., Chicago, designer and manufacturer of the "Bates" one-piece steel pole, has just published the 1921 edition of its steel pole treatise. The treatise is a compact engineering handbook of value to engineers and pole users and contains information useful in the construction of transmission lines, street-lighting systems and outdoor substations.

Electric Storage Battery Co., Allegheny avenue and 19th street, Philadelphia, Pa., is sending out a reprint of an article on "Port Newark Terminal's Freight Handling System," recently published in an Eastern magazine in which the work performed at the terminal by industrial trucks and tractors equipped with "Ironclad-Exide" batteries, manufactured by the company, is set forth.

Wisconsin Electric Co., Racine, Wis., has issued a new general catalog in which the line of "Dumore" products manufactured by the company are described in detail, the descriptions being accompanied by illustrations. The "Dumore" products consist of electrically operated grinders, drills, fractional horsepower motors and other appliances.

Combustion Engineering Corp., New York City, has leased for a long term of years property at 43 Broad street, New York City. The property has a frontage of 63 ft. and the transaction involves a total of over $1,500,000. The corporation is tearing down the old buildings on the property and will soon begin the construction of a modern building on the site to be used as headquarters.

Square D. Co., manufacturer of safety switches, Detroit, Mich., announces the appointment of D. H. Colcord as advertising manager. Mr. Colcord was formerly director of research engineering for the company and came to it from the publicity department of the Westinghouse Air Brake Co., Pittsburgh, Pa. Mr. Colcord has contributed articles to

ELECTRICAL REVIEW and other publications.

A. C. Electrical Manufacturing Co., Dayton, O., has increased its capital stock from $100,000 to $600,000. The company recently purchased the plant and equipment of the Dayton Electrical Manufacturing Co. Plans for a steel and concrete factory, the first unit of which will occupy 100,000 sq. ft. of floor space, are now being prepared. K. R. Jacoby is the president of the company.

Central Electric & Lock Co., 12 North 13th street, Philadelphia, Pa., is making rapid progress on alterations and improvements in the structure at 1309 Arch street, to which location the company will remove its establishment upon the completion of the work.

De Laval Steam Turbine Co. Trenton, N. J., is sending out a large catalog describing centrifugal pumps of the single-stage and multi-stage types for various services. Many of the pumps are equipped for electric motor drive. In addition the catalog contains various tables of matters of interest to engineers.

Esterline Co., Indianapolis, Ind., announces the appointment of the Ludwig Hommel & Co., Rose building, Cleveland, O., as agents in that territory. The company also announces the appointment of Linn O. Morrow, Franklin Trust building, Philadelphia, Pa., as representative for eastern Pennsylvania, southern New Jersey, the states of Maryland and Delaware and the District of Columbia.

Page Steel & Wire Co., 30 Church street, New York City, has published a pamphlet describing the electrical and physical properties of "American" ingot iron wire. This is the first complete publication of this data and the result of tests made during the past two years under the supervision of the Electrical Testing Laboratories, New York City, and Frank F. Fowle, consulting electrical engineer of the Page company.

E. C. Atkins & Co., Indianapolis, Ind., manufacturers of saws, have found a new outlet for their output that, though extremely limited in its scope, is quite novel. The company has sent out an article entitled "Music Hath Charms When Played on an Atkins Silver Saw," in which is told the story of a vaudeville performer who plays popular and classic music with the aid of an "Atkins" saw and an ordinary violin bow.

Wellman - Seaver - Morgan Co., Cleveland, O., has announced the election of John A. Penton, president of the Penton Publishing Co., as a director to fill the vacancy caused by the recent death of Samuel T. Wellman. Mr. Penton brings to the company an intimate knowledge of the iron and steel trade, a keen insight into business matters and a wide acquaintanceship with prominent men in all lines of industry in this and many foreign countries.

Apex Electrical Distributing Co., Cleveland, O., owing to increased sales activities, has found it necessary to appoint seven new district managers since Feb. 1. W. E. Finch, J. V. Guilfoyle and C. F. Fehrenbach are assisting District Manager G. A. Buckley in the Middle West; John Hartshorne, Jr., is assisting District Manager W. W. Wooledge in the East and R. H. Short, H. W. Somers and Leon Spencer are helping out District Manager F. W. Price in the southern territory.

B. & K. Manufacturing Co., manufacturers of portable lamps, with factory at New Haven, Conn., has moved its New York City executive sales office and showroom from 200 Fifth avenue to the eighth floor of the Grand Central Palace, Lexington avenue and 46th street, the change in location being due to increased business. The company announces that it has completed arrangements with Henri Raphael Cook, 1 University place, New York City, whereby the company becomes exclusive distributors of the "Raphael" silk parchment lamp shades.

Westinghouse Electric International Co., 165 Broadway, New York City, is issuing a monthly magazine, whose columns will be devoted to the electrical industries throughout the world. The publication, which is printed in English, contains engineering, semi-technical merchandising and popular articles, together with international electrical news. A feature of the magazine is a pictorial section which illustrates some of the engineering feats of this country. The publication is for foreign distribution and beginning with the July issue portions of it will be printed in Spanish and Portuguese.

National Conduit & Cable Co., Inc., Hastings-on-Hudson, N. Y., has recently opened two new branch offices Frank T. Payne represents that company and its subsidiary, the National Brass and Copper Tube Co., Inc., in the states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas, with headquarters in the Commercial Bank building, New Orleans, La. Wallace M. Cutler, whose territory covers Ohio, a portion of Michigan, and the states of Kentucky and Tennessee, has opened an office in the Hippodrome building, Cleveland, O.

Western Electric Co., 195 Broadway, New York City, has issued its fourth annual sales manual on home appliances, also a special manual devoted to advertising and sales helps on electric power and light for the farm. Chief among the features included in the latter manual is a 24-page booklet entitled "The Story of Shetrone Farm," containing 28 photographic reproductions illustrating different phases of farm power and lighting. There is also included a sample copy of the 96-page "Farmers' Power and Light Handbook," containing very complete, simplified information regarding the application of electricity on the farm, as well as a catalog of the entire Western Electric power and light equipment. Described in the manual is a 4-reel photoplay based on electrification of the farm, and plans and suggestions for county fair exhibits. The manual devoted to sales promotion for 1920 contains 36 pages, 11 by 24 ins., devoted to elaborately prepared dealer helps for portable sewing machines, vacuum sweepers, washers and wringers, dish washers, flatirons, general advertising matter and plans, direct mail plan, advertising by motion pictures and the program of national advertising.

Milliken Brothers Manufacturing Co., Inc., Woolworth building, New York City, manufacturer of steel transmission towers, radio towers, steel poles, and all-steel industrial buildings known as "Milliken Buildings," is now devoting the greater part of operations to the last noted specialty. These buildings are used by electric companies for substations, storage buildings, warehouses and other utility structures. To give customers service, the company has arranged for branch offices in the following cities with representatives as noted: Chicago, Majestic building, the Gagen Sales Corp.; Cleveland, Builders' Exchange, the Clymonts-Mohrman Co.; Raleigh, N. C., Structural Supply Co.; New Orleans, La., Ole K. Olsen, 822 Perdido street; Tulsa, Okla., Industrial Construction Co.; Dallas, Tex., Moore, Shotts & Wilson Co., 1504 Commerce street, Houston, Tex., David M. Duller, Houston Land & Trust building. The Milliken Manufacturing Syndicate, Ltd., London, will handle business in various European countries, while Australian territory will be covered by Gordon & Gotch, Ltd., Melbourne, Australia, with branch offices in other cities.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has announced a number of promotions in the industrial department, which includes the appointments of five assistants to managers and 16 new section managers. Otto F. Stroman, formerly manager, price section; Brent Wiley, formerly manager, steel mill section; W. H. Patterson, formerly manager, resale section; Bernard Lester, formerly manager, small motors section, and A. E. Hitchner, formerly manager, mining section, have been appointed assistants to manager, industrial department. Mr. Stroman will be in general charge of commercial activities, the development of new apparatus, prices and literature. Under his direction F. C. Reed will be manager of the price section. Under Mr. Wiley's general direction of mill industries, the following men have been appointed managers of sections; J. R. Olnhausen, textile; T. E. Simpers, general mill; E. A. Hurme, steel mill; W. H. Artz, paper and milling. Under Mr. Patterson the following men have been appointed managers in the metal working and wood working industries sections: C. W. Harris, railroad shop; W. W. Reddie, metal working; J. A. Franklin, wood working; A. M. Jones, machinery manufacturers; L. C. McClure, material handling. Under Mr. Lester's general direction of small motor and merchandising activities the following men have been appointed managers of sections: V. M. Beeler, small motor applianees; J. A. Clark, merchandising; H. A. Campe, domestic service; R. B. Harvey, farming. Under Mr. Hitchner the following men have been appointed managers in mining industries sections: E. E. Boon, coal mining; C. B. Gibson, metal mining and chemical.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

WALTER C. WILLARD has been appointed consulting engineer for the Steel Products Co., Cleveland, O.

ROBERT P. WOODS has been appointed vice-president and general manager of the Kansas City, Clay County & St. Joseph Electric Railway Co.

DANIEL C. ROPER, former United States Commissioner of Internal Revenue, has been elected president and a director of the Marlin-Rockwell Corp., New Haven, Conn.

DR. JOHN BOSWELL WHITEHEAD, professor of electrical engineering at Johns Hopkins University, Baltimore, Md., has been appointed dean of the department of engineering.

CHARLES BROSSMAN, Indianapolis, Ind., was made chairman of the Indiana Section, American Society of Mechanical Engineers, at its recent annual meeting held in Indianapolis.

JACK H. RISSER, manager of electric sales for the Globe Stove & Range Co., Kokomo, Ind., resigned his position on April 30. Mr. Risser has not formulated any plans for the future as yet.

DANIEL G. WING, president of the First National bank, Boston, Mass., has been elected to the board of directors of the American International Corp. Mr. Wing succeeds the late Theodore N. Vail.

FRANK H. WILSON, former chief of production of the Detroit district of the government air service, has been appointed supervisor of purchases for the Lincoln Motor Co., Detroit, Mich.

H. D. SHUTE, vice-president of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has been elected a director of the West Virginia Metal Products Corp., Fairmont, W. Va.

WALTER J. FROST, president of the Frost Manufacturing Co., Kenosha, Wis., was re-elected president of the Kenosha Manufacturers' Association at the recent annual meeting of the association.

THOMAS O'BRIEN, who since 1908 has been district manager of the American Sheet & Tinplate Co., Elwood, Ind., has been made general manager of the Farrell works of the company, Sharon, Pa.

LOUIS H. EGAN, vice-president and general manager of the Union Electric Light & Power Co., and of the St. Louis County Gas Co., St. Louis, Mo., has been elected president of both companies, succeeding J. D. Mortimer.

GUY E. TRIPP, chairman of the board of directors of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has been elected a director of the American Water Works & Electric Co., Inc., 50 Broad street, New York City.

GEORGE C. EGGERS has resigned as district manager for the E. T. Chapin Co., and is now at the head of the Eggers Pole & Supply Co., with offices at 327 South La Salle street, Chicago.

WILLIAM MILNES MALOY, of Annapolis, Md., has been appointed a member of the Maryland Public Service Commission by Governor Ritchie. Mr. Maloy was named chairman of the board, and succeeds Milton Reifsnider, recently deceased.

CHARLES L. EDGAR, appointed chairman of the Executive Committee of the Society for Electrical Development at its recent annual meeting, has

Charles L. Edgar.

spent almost 40 years in the electrical industry, and since 1900 has been president of the Edison Electric Illuminating Co. of Boston. Born in New Jersey in 1860, Mr. Edgar graduated from Rutgers College in 1882 and, after taking a post-graduate course in electrical engineering, accepted a position in the testing department of the Edison Machine Works, New York City. In 1887 he was transferred to Boston as general manager of the company he is now with. He was made a vice-president in 1890, retaining that office until the death of Jacob Rogers in 1900, when he became president. Mr. Edgar is a member of many electrical and engineering societies and is prominent in the work of the National Electric Light Association.

CHARLES V. HALLEY, JR., New York City, has been appointed deputy public service commissioner by Public Service Commissioner Lewis Nixon. Mr. Halley succeeds Edward J. Glennon, recently appointed justice of the Supreme Court by Governor Smith.

G. H. JAMISON and H. S. PECK, formerly connected with the Chicago, Milwaukee & St. Paul railway electrification work in Washington, are now connected with A. H. Cox & Co., engineers and contractors, 307 South First avenue, Seattle, Wash.

GEORGE E. QUINLAN, chief electrical engineer of the Puget Sound Power & Light Co., Seattle, Wash., has been elected chairman of the Seattle Section of the American Institute of Electrical Engineers.

H. A. LEMMON, formerly sales manager with the Truckee River General Electric Co., Reno, Nev., has taken charge of an advertising campaign being instituted by the Nova Scotia Tramways & Power Co., Halifax, N. S.

L. E. TROTTER, assistant sales manager of the Post-Glover Electric Co., Cincinnati, O., was elected a director of the company at the recent annual meeting. Mr. Trotter is well known in Cleveland and Denver, in which cities he formerly represented the Crocker-Wheeler Co.

F. W. SINRAM, president of the Van Dorn & Dutton Co., Cleveland, O., was re-elected president of the American Gear Manufacturers' Association at its recent annual meeting. This is the fourth time Mr. Sinram has been elected president of the organization. As a token of the regard in which Mr. Sinram is held by his fellow-members in the association he was presented with a gold watch.

EDWARD B. RICHARDSON and HARRY GAY have formed a partnership under the name of Richardson & Gay, consulting engineers, with offices at 220 Devonshire street, Boston, Mass. Mr. Richardson, formerly of Richardson & Hale, consulting engineers, was recently discharged from the army with the rank of lieutenant-colonel, after serving overseas with the 26th division, field artillery. He is a member of the American Society of Mechanical Engineers, associate member of the American Institute of Electrical Engineers and a graduate of the Massachusetts Institute of Technology, class of 1898. Mr. Gay has been attached to the construction and engineering department of Stone & Webster, Boston, Mass., during the past nine years. He is a member of the American Society of Mechanical Engineers.

OBITUARY.

V. M. PRIEST of the Advance Electric Co., Oakland, Cal., died recently.

JAMES R. NELSON, superintedent of the San Joaquin Light & Power Co. substation at Springville, Cal., died recently at a Porterville (Cal.) hospital.

JOHN J. CONVERY, consulting engineer with an office at 19 West 44th street, New York City, died recently at Worcester, Mass. He was 49 years of age.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Providence, R. I.—Announcement has been made by the Narragansett Electric Lighting Co. that plans are being arranged for the erection of a number of new buildings on a tract of land comprising about 10 acres recently acquired in the Melrose Park district, fronting on the New York, New Haven & Hartford railroad. The proposed work will include a large service plant, as well as a number of administration buildings, with service buildings for meter, arc lamp, underground cable and transformer departments. A large storehouse and a garage for company cars will also be constructed.

Providence, R. I.—The American Woolen Co., Weybosset street, has completed plans and awarded contract for the construction of a new power plant at its mills. The structure will be of reinforced concrete type, and will comprise a boiler room, about 35 by 35 ft., as well as turbine, department, about 54 by 52 ft. Williams & Merchant, Providence, are the building contractors.

Bridgeport, Conn.—The Hawthorne Co., manufacturer of lamps for automobiles, motorcycles, bicycles, etc., is arranging for the sale of its plant near Bridgeport, known as the "Old Sol" plant. The property comprises about 5½ acres of land, with a total manufacturing area of 54,080 sq. ft., and is located on the New York, New Haven & Hartford railroad.

Bridgeport, Conn.—The Columbia Graphophone Co. has inaugurated work on the construction of a new 1-story transformer building on Railroad avenue.

Hartford, Conn.—The city has authorized the preparation of plans and specifications for the construction of a new central heating plant and laundry at the isolation hospital and almshouse. The project is estimated to cost about $77,000, and laundry machinery and other equipment will be required. Whiton & McMahon, Hartford, are the architects on the project.

Aurora, N. Y.—The East Aurora Electric Light Co. is understood to be arranging for general business expansion. Notice has recently been filed of an increase in its capitalization from $20,000 to $50,000.

Brooklyn, N. Y.—American Safety Razor Co., 303 Jay street, has arranged for the construction of a new 1-story brick boiler plant, about 25 by 50 ft., for factory service in connection with the erection of its new 5-story plant at Lawrence, Johnson and Jay streets.

Central Islip, N. Y.—The State Hospital Commission, Albany, E. S. Elwood, secretary, has awarded a contract to the G. E. Engineering Co., Laight and Varick streets, New York City, for the installation of a new electric fire alarm system in the Central Islip State Hospital, estimated to cost $12,150.

Far Rockaway, N. Y.—The Queens Borough Gas & Electric Co., 347 Central avenue, has had plans prepared for alterations and improvements, as well as the construction of a new 2-story brick extension to its local power plant, about 38 by 53 ft. The work is estimated to cost $34,390.

Jamaica, L. I., N. Y.—The Dictograph Products Corp., 220 West 42nd street, New York City, has completed foundations in connection with the construction of the proposed new local plant at Schoeley place and Chichester avenue, estimated to cost $25,000. The company manufactures electrically operated devices, and the new works will be used for increased operations.

New York, N. Y.—Considerable electrical equipment, refrigerating apparatus, etc., will be used in connection with the construction of the proposed new cold storage plant of the Brooklyn Bridge Freezing & Cold Storage Co.

New York, N. Y.—The New York Telephone Co., 15 Dey street, is planning for the inauguration of work at an early date on the construction of a large new automatic telephone exchange plant on property recently acquired, about 102 by 215 ft., at 119 West 73rd street, between Columbus and Amsterdam avenues. The company has also awarded a contract to M. Eidlitz & Son, New York City, for the construction of an addition to its building at Broadway and Fulton street.

New York, N. Y.—The Elvin Mechanical Stoker Co., 30 Church street, has filed notice of an increase in its capitalization from $500,000 to $1,500,000, for general business expansion.

New York, N. Y.—The New York Edison Co., Irving place and 15th street, has arranged for the purchase of two 3-story business buildings at 120 Cedar street.

Glen Ridge, N. J.—The borough council is arranging plans for the installation of a new electric street-lighting system, "white way" type, on Bloomfield avenue.

Jersey City, N. J.—The American Butterine Co., 1 Montgomery street, has awarded a contract for the construction of a new manufacturing building and power plant. The structures will be located on Henderson street, and are estimated to cost about $100,000.

Newark, N. J.—Plans have been prepared for the construction of a new engine plant and boiler room, about 30 by 60 ft., in connection with the erection of the new plant of Phineas Jones & Co., 305 Market street, manufacturer of automobile wheels, etc., to be located on property recently acquired in the Hillside district comprising about 15 acres.

Newark, N. J.—The Isbell-Porter Co., 46 Bridge street, manufacturer of engines, etc., has filed notice of an increase in its capitalization from $175,000 to $400,000.

Newark, N. J.—The city council has completed arrangements for extensions in the "white way" electric street-lighting system in Park place and Broad street. The Broad Street Improvement Association has been active in promoting this project.

Trenton, N. J.—Notice has been filed by the DeLaval Steam Turbine Co., North Clinton street, of an increase in its capitalization from $1,500,000 to $2,500,000.

Trenton, N. J.—The Board of Managers of the New Jersey State Home for Girls has taken bids for the installation of new laundry equipment and the construction of a laundry building at the institution, estimated to cost about $35,000.

Trenton, N. J.—The Electric Porcelain & Manufacturing Co., 747 New York avenue, has awarded contracts for the construction of two new buildings, to be located on Pennsylvania and New York avenues.

Carlisle, Pa.—Work has been completed by the Centerville Rural Telephone Co. on the connection of its lines with those of the Cumberland Valley Telephone Co.

Collingdale, Pa.—Jobson Chocolate Co. has had plans prepared for the construction of a new local plant and boiler house, brick and concrete type.

Harrisburg, Pa.—A number of public utility companies have filed notice with the State Department of the issuance of bonds and stock for proposed expansion. These include: Metropolitan Edison Co., Reading, $2,500,000 preferred stock; Philadelphia Rapid Transit Co., Philadelphia, bonds, $500,000, $420,000, and $39,000; Philadelphia & Garrettsford Street Railway, Upper Darby, bonds, $225,000; and the Hammond Water Co., Philadelphia, bonds, $10,000.

Philadelphia, Pa.—The Emergency Fleet Corp. is arranging for the sale of the Hog Island shipyard including power plant, machinery and equipment. Proposals for the works will soon be asked.

Philadelphia, Pa.—The Columbia Carpet Co., Third and Huntingdon streets, has awarded a contract to the William Steele & Sons Co., 1600

Arch street, for the erection of a new addition to its engine plant.

Philadelphia, Pa.—The H. Belfield Co., 435 North Broad street, manufacturer of steam specialties, is planning for improvements at its plant, estimated to cost about $10,000.

Philadelphia, Pa. — Philadelphia Electric Co., has awarded a contract to the John R. Wiggins Co., Otis Building, for the construction of a 2-story plant at 52 North Sixth street, about 50 by 98 ft., estimated to cost $140,000.

Philadelphia, Pa.—The Crane Co., manufacturer of steam specialties, has completed plans for the construction of a new 1-story brick pipe bending shop, about 60 by 200 ft., at Master street and Germantown avenue.

Philadelphia, Pa.—Provision has been made by the House Appropriations Committee, Washington, D. C., in connection with the preparation of the appropriations bill for the sums of $270,000 for the completion of the electric power plant at the Frankford Arsenal, and $88,000 for the installation of an electric transmission system at the property.

Scranton, Pa.—Plans have been completed by A. & P. J. Casey, 214 Lackawanna avenue, for the construction of a new power plant in connection with the erection of a new laundry and loft building, 5-stories high, at Dix and Lee courts.

Milford, Del.—At a recent special election citizens voted to issue bonds for $21,000, the proceeds to be used for the installation of new modern equipment and machinery in the municipal electric lighting plant. It is proposed to replace the direct system at present in use with an alternating current in connection with the proposed work, which it is planned to have completed by fall.

Baltimore, Md.—The board of estimates has made an appropriation of $150,000 to provide for the construction of a new municipal fire alarm station.

Cecilton, Md.—The Cecilton Electric Light & Power Co. is understood to be arranging plans for the reconstruction of its power plant recently destroyed by fire.

Hagerstown, Md.—The city is having plans prepared for the construction of the proposed new municipal electric power plant. Bonds for $300,000 were recently voted to cover the cost of this project, and it is understood that bids for the work will be asked at an early date. A. B. Grubmyer, 21 East Franklin street, is the engineer in charge.

Martinsburg, W. Va.—The Interwoven Mills, New Brunswick, N. J., is understood to be considering plans for the construction of a large new electrical power plant to be used for general factory operation for its local plant. The new station is estimated to cost in excess of $50,000.

Hickory, N. C.—The Latta-Martin Pump Co. has filed notice of an increase in its capitalization from $50,000 to $200,000.

Winston Salem, N. C.—The R. J. Reynolds Tobacco Co. has awarded a contract for the construction of a new local 1-story brick and concrete power plant, estimated to cost about $50,000.

Youngville, N. C.—The city council has authorized the issuance of bonds for $20,000, the proceeds to be used for the construction of a new municipal electric light system. J. R. Pearce is the mayor of the city.

Adel, Ga.—The city has voted $12,000 in bonds for the purpose of extending the electric light and water works system.

Bainbridge, Ga.—The Bainbridge Power Co. has completed arrangements for the proposed new water power development on Spring creek, estimated to cost in excess of $75,000. The work will include the construction of a new reinforced concrete power house, with dam, to have a power head of 17 ft., and it is understood that it is planned to develop in excess of 700 hp. for initial work. Construction contracts have been awarded to A. Dallam O'Brien, 1641 Amelia street, New Orleans, La.

Soperton, Ga.—The city council has called an election May 28 for the purpose of voting bonds for $10,000, the proceeds to be used for the installation of a new municipal electric light plant.

Fort Pierce, Fla.—The city will enlarge the municipal electric light and water plant to provide greater capacity.

NORTH CENTRAL STATES.

Kenton, O.—The Champion Engineering Co. will build additions to its plant and improve the condition of present buildings at a total expenditure of about $1,000,000.

Port Clinton, O.—An electrically operated shovel and conveying machinery will be installed by the Port Clinton Lumber Co.

Troy, O.—The city will issue $200,000 in bonds for the construction and equipment of a new electric light plant.

Anderson, Ind.—The General Motors Corp. announces that its amature winding department, temporarily transferred to Muncie several months ago, will be returned to the Remy Electric Co. plant at Anderson.

Auburn, Ind.—The city is planning improvements in the electric light and water systems. Froehlick & Emery, Toledo, O., are the engineers in charge of the project.

South Bend, Ind.—The Stephenson Underwear Mills has increased its capital stock from $1,000,000 to $1,800,000.

Belvidere, Ill. — The city park board proposes to utilize the water power in a mill race to operate an electric lighting system for the parks. Address secretary of park board for further information.

Chicago, Ill.—The Monighan Machine Co., 2016 Carroll avenue, will erect a machine shop at a cost of $80,000.

Chicago, Ill.—The Lehigh Portland Cement Co. is expected to start work soon on a power house, 60 by 140 ft.

Chicago, Ill.—The Union Railway Equipment Co., 322 South Michigan avenue, is taking bids for a 1-story foundry at Hammond, Ind., to cost about $125,000.

Chicago, Ill.—The McDonald Machine Co., 7600 Racine avenue, will build a 1-story machine shop, 150 by 400 ft., to cost about $200,000, including equipment.

Mansfield, Ill.—The Mansfield Electric Co. has completed arrangements for the construction of a transmission line to Mahomet, where it will connect with a line from Champaign. This will give Mansfield a 24-hour service.

Battle Creek, Mich.—Plans for the extension of the ornamental street-lighting system on Lake avenue are under way.

Detroit, Mich.—The Swedish Crucible Steel Co. will build a 4-story addition to its factory.

Black Earth, Wis. — The Black Earth Electric Light Co. will build and operate transmission lines to serve farmers in the territory west of Black Earth. Fred Booth is secretary of the company.

Washburn, Wis.—The proposition to acquire the Washburn Electric Light & Power Co. for municipal operation will be voted on by the citizens in the near future.

Young America, Wis.—The Woodford Engineering Co. will build a 2-story brick and concrete machine shop addition, 44 by 120 ft.

Clarion, Ia.—The Northern Iowa Gas & Electric Co. plans to organize a farmers' mutual service electric light and power company. O. P. Morton is in charge of the project.

Davenport, Ia.—The Peoples Light Co. will span the Mississippi river with a high-power transmission line to supply electrical energy for the Western States Portland Cement Co. plant. The transmission towers will be 125 ft. high and with equipment and construction expense will cost about $125,000.

Fairfield, Ia.—The Dexter Washing Machine Co. is having plans drawn for an addition to its plant, 1-story in height, 80 by 140 ft., to cost $30,000.

Red Oak, Ia.—The city is considering the erection of a municipal electric light plant at an estimated cost of $149,000.

Carthage, Mo.—The city light and water works is in the market for a crude oil Diesel-type engine of about 100 hp. M. Lipscomb is superintendent of the plant.

Johnson, Neb.—The city has voted $16,000 in bonds to build a distributing system in the city and to build a transmission line to obtain electric power from Auburn, Neb.

Watertown, S. D.—The city council has approved plans for the construction of an electric light and power plant for which $200,000 in bonds have been voted. B. N. Hagan is mayor of the city.

Bismarck, N. D.—The Jamestown-Medina High Line Co. will construct power lines from Jamestown to Medina and furnish electric power to

consumers at Eldridge, Windsor, Cleveland and Medina. F. F. Stage, Medina, N. D., is the manager of the company.

Doland, S. D.—The city has voted $17,000 in bonds for improvements and installation of new machinery at the municipal electric light plant.

Timmonsville, N. D.—The municipal electric light and gas plant, recently burned, is being rebuilt.

SOUTH CENTRAL STATES.

Lothair, Ky.—Kentucky & West Virginia Power Co., Land Title building, Philadelphia, Pa., is planning for extensions and improvements in its plants and system at Lothair, for increased operations. The proposed work includes the installation of two 500-hp. capacity boilers; extensions in its 33,000-volt transmission lines to Yellow Creek in Knott county; extension of the 6,600-volt transmission lines from Blackey to Ulvah, Ky., as well as other work. F. R. Weller, Washington, D. C., is the consulting engineer for the company.

Cleveland, Tenn.—The city is arranging plans for the immediate installation of a new electrically operated pumping unit for the municipal waterworks plant, for increased operations.

Knoxville, Tenn.—The Board of Managers of the Fort Sanders Hospital is having plans prepared for the construction of a new power plant and laundry building at the institution, reinforced concrete and brick type. Considerable electrical laundry machinery, etc., will be utilized.

Gadsden, Ala.—The Alabama Power Co. will rebuild its distributing lines. G. W. Ashmead is the local manager of the company.

Moss Point, Miss.—The city will issue $10,000 in bonds for the purpose of installing an electric light system. C. M. Fairley is the city clerk.

DeRidder, La.—The De Ridder Light & Power Co. is planning for the installation of new electrical equipment, including engine, generator and auxiliary apparatus. M. B. Morgan is treasurer of the company.

Beaumont, Tex. — The Eastern Texas Electric Co., operating at Beaumont, Port Arthur, and other municipalities, has arranged for a bond issue of $1,500,000, a portion of the proceeds to be used, it is understood, for improvements at its plant, including the installation of a new 4000-kw. turbogentor. C. F. W. Wetterer is the president of the company.

Cameron, Tex.—J. Frank Elder has submitted a proposition to the people of Cameron for the construction of an interurban electric railway between here and Waco, about 50 mi. It is estimated that the cost of making the survey for the proposed line will be about $40,000 which will be borne by the towns along the route. The citizens of Cameron have agreed to subscribe to $100,000 of stock of the company when it is organized.

Dallas, Tex.—The Dallas Railway, Interurban building, is planning the erection of a new electric power plant, to cost, with transmission system, in excess of $1,000,000.

Houston, Tex.—H. D. Brock, superintendent of parks, has recommended a new system of electric lighting for the city parks.

Port Arthur, Tex.—Upon application of the National Utilities Co. the Port Arthur Gas and Power Co. has been placed in the hands of a receiver. The company's liabilities are scheduled at more than $250,000 and assets at about $200,000.

WESTERN STATES.

Billings, Mont.—The city council has passed ordinances providing for electric street lighting on Broadwater, Wyoming, Yellowstone and other streets. W. Lee Mains is mayor of the city.

Everett, Wash.—The city will expend $50,000 in betterments and extensions of the municipal light and power system.

Morton, Wash.—J. B. Campbell, Springfield, Ill., has purchased the power plant and business of the Morton Electric Co. from C. S. Haggerty. Mr. Campbell was formerly connected with the Illinois Public Utility Commission in the capacity of engineer.

Tacoma, Wash.—The St. Paul & Tacoma Lumber Co., has ordered a 2500-kw. steam turbine unit from the Allis-Chalmers Manufacturing Co. and will use it in completing the electrification of its mills at Tacoma. A 1000-kw. engine has been in operation at the mills for some time.

CANADA.

Hamilton, Ont.—The city is planning the installation of a fire-alarm system, to cost about $110,000. A. B. Ten Eyck is chief of the fire department.

Montreal, Que.—The St. Lawrence Welding Co. is building an addition to its plant.

Montreal, Que. — The Dominion Government Harbor Commissioners are building a cold storage and power plant.

Welland, Ont. — The Canadian Mead-Morrison Co., manufactures of hoisting machines, etc., plans to enlarge its plant and extend its operations.

INCORPORATIONS.

New York, N. Y.—Daylyte Lamp Co. Capital stock, $50,000. To manufacture electric lamps, etc. Incorporators: K. Kiely, P. J. Mee, and W. B. Boinset, 413 Greenwich street.

New York, N. Y.—P. M. Lamp Co. Capital stock, $10,000. To manufacture incandescent lamps. Incorporators: M. L. Rippe, I. M. Prokofieff, and J. Michael, 155 Gerard street, Brooklyn.

Brooklyn, N. Y.—K. E. M. Co. Capital stock, $50,000. To manufacture motors, etc. Incorporators: O. Erickson, J. A. Kulier, and A. E. Latham, 52 Lincoln place.

New York, N. Y.—Dominion Pulp Power Co. Capital stock, $400,000. To operate electric generating plants. Incorporators: A. V. Fox, D. R. Baldwin, and M. P. Winne, 27 Pine street.

Troy, N. Y.—Reddy & Small Electrical Co. Capital stock, $10,000. To manufacture electrical goods. Incorporators: M. M. and W. G. Reddy, and H. W. Small, Upper Troy.

Rochester, N. Y.—Phillips Electric Co. Capital stock, $100,000. To manufacture electrical specialties. Incorporators: L. E. Weyraugh, W. F., and J. J. Phillips, Rochester.

New Haven, Conn.—Electric Sun Co., of New Haven, Inc. Capital stock $50,000. To manufacture electric signs, etc. Incorporators: William Van Vleck, Asbury Park, N. J.; L. A. O'Brien, and John Elliott, New Haven.

Mount Carmel, S. C.—Little River Light & Power Co. Capital, $20,000. L. L. Hester is president and treasurer, and C. M. Hester, secretary.

Brooklyn, N. Y.—The Grand Lighting Fixture Co. has been incorporated with capital stock of $5000 by S. Halpern, A. Pfferberg and K. Hoff, 210 Scholes street.

FOREIGN TRADE

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Electrical Appliances (32,610)—A commercial firm in Spain desires to secure an agency for the sale of electrical appliances. Quotations should be given c. i. f. Alicante, Valencia or Barcelona. Payments on sale of goods. Correspondence should be in Spanish.

Electrical Apparatus (32,622) — A commercial agent in France desires to secure the agency for the sale of electrical apparatus. Correspondence should be in French.

Electrical Suction Cleaner (32,608) —A merchant in England desires to be placed in communication with the manufacturer of an electrical suction cleaner similar to one which is being sold on the English market, with a view to purchasing. A leaflet illustrating the English cleaner was forwarded and may be examined at the Bureau or its district offices. (Refer to file No. 2314.) Quotations should be given c. i. f. Liverpool. Payment cash.

Electrical Supplies and Appliances (32,605)—A merchant in Switzerland desires to purchase electric supplies and implements of all kinds for the wholesale trade, such as sockets, switches, pull switches, cut-outs, flat steel wire clasps, small electric motors (1/10 and 1/25 P. S.), and resisting wire for heating apparatus, all to be best quality articles. Quotations should be given f. o. b. port of shipment. Payment or receipt of goods or against documents before shipping. Correspondence may be in English.

CHICAGO TRUST COMPANY

FORMER NAME CHICAGO SAVINGS BANK AND TRUST COMPANY

LUCIUS TETER, PRESIDENT.

JOHN W. O'LEARY, VICE PRESIDENT.
EDWARD P. BAILEY, VICE PRESIDENT.
JOHN A. McCORMICK, VICE PRESIDENT.
W. T. BACON, VICE PRESIDENT.
F. O. BIRNEY, VICE PRESIDENT.
FREDERIC S. POPE, CASHIER.
MAX STEINER, ASSISTANT CASHIER.
C. W. BLACKWELL, ASSISTANT CASHIER.

STATE AND MADISON STREETS

CHICAGO

WILLARD F. HOPKINS, SECRETARY.
WILLIAM T. ANDERSON, ASST. SECRETARY.
ROY K. THOMAS, TRUST OFFICER
ARTHUR B. CODY, } ASSOCIATE MGRS.
HIRAM S. CODY, } REAL ESTATE LOAN DEPT.
D. D. KLEDER, AUDITOR.

May 3, 1920

My Dear Mr. Tupper:

My attention has been called to a recent copy of the Electrical Review and I am particularly interested in the discussion concerning "Good Will as a Basis of Credit".

Here at the Chicago Trust Company, and, I have no doubt it is true of most bankers of the present day, we have long since learned that a business does not consist purely of what the financial statement of the concern may show as its assets and liabilities. There is suggested two more important items,—first, the character and ability of the management, either to manufacture or to sell products; second, the demand for the product manufactured and offered for sale, and this demand on the part of the public in these days of general competition is largely dependent upon the question of how many people know about the concern and its products. In other words, there is a tremendous factor of value made up in the expression "Good Will" and this good will in its final analysis is based upon the ability to make the right goods at the right price, and advertising them sufficiently, so that enough people may know of the goods at the right price. It is unnecessary to say that no amount of advertising will make good will for inferior goods, but it is quite true that proper advertising will add tremendously to the good will of a concern that makes good goods and offers them at a fair price.

I shall be very much interested in the further development of this subject in your most excellent journal.

With cordial personal regards, I am,

Sincerely,

Lucius Teter

Mr. C. A. Tupper, President,
International Trade Press,
542-55 Monadnock Block,
Chicago.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Dallas Light & Power Co. to Issue $140,000 in Notes.

The Dallas Power & Light Co. has applied to the city commission for authority to borrow $140,000 on 2-year 7% notes, pledging $175,000 of its 30-year first mortgage 6% bonds for collateral, and to sell $500,000 of these bonds, including those pledged, which are now held in the company's treasury, when the notes are paid. The commission gave the power company authority to issue $5,000,000 bonds June 30, 1919, and $1,500,000 preferred stock, with the proviso that $500,000 of the stock was not to be issued and $500,000 of the bonds were to be placed in the company's treasury and not to be touched without the consent of the commissioners.

Greenfield Tap & Die Co. Declares Stock Dividend.

The Greenfield Tap & Die Corp. has declared a 50% stock dividend on the common stock, payable July 1 to stockholders of record June 4. This increases the common stock capitalization from 80,000 to 120,000 shares of $25 par value. The directors also declared the regular quarterly dividend of $1 a share on the present common stock, payable July 1 to stockholders of record June 4.

Duquesne Light Co. Stockholders to Vote on Stock Issue.

The stockholders of the Duquesne Light Co., Pittsburgh, Pa., will vote July 6 on the proposition to increase the indebtedness from $25,000,000 to $100,000,000 through issuing $75,000,000 additional first mortgage and collateral trust 30-year gold bonds.

Republic Railway & Light Co.

Earnings of the Republic Railway & Light Co. and subsidiaries for March and the twelve months ended March 31, 1920, compare with 1919 as follows:

	1920.	1919.
March gross	$ 687,099	$ 525,271
Net after taxes	172,815	107,604
Total income	190,404	153,943
Surplus after charges	64,848	39,545
Balance after preferred dividends	38,891	13,588
Twelve months' gross	6,750,156	5,674,787
Net after taxes	1,687,097	1,380,339
Total income	1,868,162	1,564,460
Surplus after charges	478,789	263,256
Balance after preferred dividends	167,305	*48,227

*Deficit.

American Light & Traction Co.

The American Light & Traction Co.'s annual report for the year ended March 31, 1920, compares with the previous year as follows:

	1920.	1919.
Gross	$ 4,428,951	$ 4,302,026
Net	4,201,139	4,028,015
Surplus previous year	11,616,783	12,832,704
Total surplus	15,717,922	16,860,719
Preferred stock cash dividend	854,172	854,172
Common stock cash dividend	2,476,480	2,244,882
Surplus March 31	9,910,790	11,516,782

Havana Electric Railway, Light & Power Co.

Earnings of the Havana Electric Railway, Light & Power Co. for the month of January, 1920, compares with January, 1919, as follows:

	1920.	1919.
January gross	$ 883,118	$ 726,358
Net earnings	446,063	348,039
Total net income	452,115	357,050
Surp. after fixed chgs.	261,418	161,920

Eastern Texas Electric Co.

Earnings of the Eastern Texas Electric Co. for January and the 12 months ended Jan. 31, 1920, compare with 1919 as follows:

	1920.	1919.
January gross	$ 130,638	$ 110,965
Net earnings	54,458	43,046
Surplus after charges	41,062	30,304
12 months' gross	1,410,033	1,158,258

The West Penn Power Co. has declared its regular quarterly dividend of 1¾% on the 7% cumulative preferred stock, payable May 1 to stockholders of record April 2.

Portland Gas & Coke Co.

The earnings of the Portland Gas & Coke Co., a subsidiary of the American Power & Light Co., for December and the 12 months ended Dec. 31, 1919, compares with 1918 as follows:

	1919.	1918.
December gross	$ 224,239	$ 173,233
Net after taxes	92,713	59,491
Total income	92,693	59,491
Sur. after int. charges	64,359	30,000
12 months' gross	2,185,367	1,797,461
Net after taxes	947,456	795,307
Total income	947,506	795,307
Sur. after int. charges	595,881	443,560
Bal. after pfd. div.	433,380	300,202

Southwestern Power & Light Co.

Earnings of the subsidiary companies operated by the Southwestern Power & Light Co. for January and the twelve months Jan. 31, 1920, compare with 1919 as follows:

	1920.	1919.	Changes. Increase.
Jan. gross	$ 748,862	$ 551,609	$197,253
Net earnings	355,817	195,681	160,136
Twelve months' gross	6,680,072	5,758,499	921,573
Net earnings	2,558,231	2,103,773	454,458

Great Western Power System.

Earnings of the Great Western Power System, consisting of the Great Western Power Co. of California and the California Electric Generating Co., for February and the twelve months ended Feb. 29, 1920, compare with 1919 as follows:

	1920.	1919.
February gross	$ 457,427	$ 409,273
Net after taxes	259,281	244,769
Surplus after interest charges	102,961	115,720
Twelve months' gross	5,496,548	4,831,661
Net after taxes	3,093,522	2,872,696
Surplus after interest charges	1,370,887	1,321,221

Sandusky Gas & Electric Co.

	1920.	1919.
March gross	$56,218	$40,808
Net after taxes	6,077	11,877

Alabama Power Co.

	1920.	1919.
March gross	$ 326,829	$ 225,853
Net after taxes	184,605	132,262
Twelve months' gross	3,337,177	3,112,379
Net after taxes	1,850,178	1,607,350

General Gas & Electric Co.

	1920.	1919.
March gross	$ 853,202	$ 694,176
Net after taxes	197,706	208,985
Twelve months' gross	9,606,148	8,239,596
Net after taxes	2,702,273	2,230,269

Reading Transit & Light System.

	1920.	1919.
March gross	$241,906	$203,593
Net after taxes	25,959	38,480

New Jersey Power & Light Co.

	1920.	1919.
March gross	$36,202	$28,497
Net after taxes	13,180	10,047

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid May 4.	Bid May 11.
Adirondack Electric Power of Glens Falls, common	6	9	10
Adirondack Electric Power of Glens Falls, preferred	6	69	70
American Gas & Electric of New York, common	10+extra	114	111
American Gas & Electric of New York, preferred	6	37	37
American Light & Traction of New York, common	..	150	150
American Light & Traction of New York, preferred	6	84	83
American Power & Light of New York, common	4	58	56
American Power & Light of New York, preferred	6	69	69
American Public Utilities of Grand Rapids, common	..	5	4
American Public Utilities of Grand Rapids, preferred	7	12	12
American Telephone & Telegraph of New York	..	101	99
American Water Works & Elec. of New York, common	..	2	2
American Water Works & Elec. of New York, particip	7	7	7
American Water Works & Elec. of New York, first preferred	..	37	40
Appalachian Power, common	..	1	1
Appalachian Power, preferred	7	15	15
Cities Service of New York, common	+extra	350	348
Cities Service of New York, preferred	6	67	67
Commonwealth Edison of Chicago	8	101	100
Comm. Power, Railway & Light of Jackson, common	..	19	19
Comm. Power, Railway & Light of Jackson, preferred	6	41	40
Federal Light & Traction of New York, common	..	6	6
Federal Light & Traction of New York, preferred	..	44	44
Middle West Utilities of Chicago, common	..	18	18
Middle West Utilities of Chicago, preferred	..	37	36½
Northern States Power of Chicago, common	..	42	42
Northern States Power of Chicago, preferred	ex.div.7	82	82
Pacific Gas & Electric of San Francisco, common	..	53	53
Public Service of Northern Illinois, Chicago, common	7	79	79
Public Service of Northern Illinois, Chicago, preferred	6	78	77
Standard Gas & Electric of Chicago, common	..	16½	15½
Standard Gas & Electric of Chicago, preferred	6	38	38
Tennessee Railway, Light & Power of Chattanooga, common	..	1	1
Tennessee Railway, Light & Power of Chattanooga, preferred	6	4	4
United Light & Railways of Grand Rapids, common	4	23	21
United Light & Railways of Grand Rapids, preferred	6	59	59
Western Power of San Francisco, common	..	15	15
Western Union Telegraph of New York	extra	79	79
Industrials—			
Electric Storage Battery of Philadelphia, common	4	102	100
General Electric of Schenectady	8	170	170
Westinghouse Electric & Mfg. of Pittsburgh, common	7	53	53